S
628.16
W3WM

WATER QUALITY INVENTORY AND MANAGEMENT PLAN

MILK RIVER BASIN
MONTANA

by

WATER QUALITY BUREAU
ENVIRONMENTAL SCIENCES DIVISION
Montana Department of Health and Environmental Sciences

Montana State Library
3 0864 1006 7278 4

WATER QUALITY INVENTORY AND MANAGEMENT PLAN
MILK RIVER BASIN, MONTANA

PREPARED BY
D. BLOOM AND M. K. BOTZ
WATER QUALITY BUREAU
ENVIRONMENTAL SCIENCES DIVISION
MONTANA DEPARTMENT OF HEALTH AND ENVIRONMENTAL SCIENCES

DECEMBER, 1974

Approved:

D. G. Willems, P.E., Chief
Water Quality Bureau
Environmental Sciences Division
Montana Department of Health and
Environmental Sciences
Helena, Montana 59601

John S. Anderson, M.D., Director
Montana Department of Health and
Environmental Sciences
Helena, Montana 59601

John A. Green, Regional Administration
Environmental Protection Agency, Region VIII
1860 Lincoln Street
Denver, Colorado 80203

Digitized by the Internet Archive
in 2015

https://archive.org/details/waterqualityinve1974bloo

CONTENTS

		Page
	LIST OF TABLES	iv
	LIST OF FIGURES	
I.	INTRODUCTION	1
II.	SUMMARY AND CONCLUSIONS	5
III.	RELATED INVESTIGATIONS AND PLANS	7
	TECHNICAL INVESTIGATIONS	7
	AREAWIDE WASTE TREATMENT PLANS	8
	SECTION 201 FACILITY PLANS	8
	LEVEL B PLANS AND OTHER FEDERAL PLANS	8
IV.	BASIN PHYSICAL CHARACTERISTICS	9
	CLIMATE	10
	HYDROGEOLOGY	14
	SOILS	16
	LAND USE	19
	WATER USE	19
	POPULATION AND ECONOMY	20
	BIOLOGICAL CONDITIONS	23
V.	MONTANA WATER POLLUTION CONTROL PROGRAM	25
	STATE AND FEDERAL WASTE DISCHARGE PERMIT PROGRAM	25
	WATER QUALITY STANDARDS	26
	STATEWIDE MONITORING AND SURVEILLANCE PROGRAM	27

Page

FACILITIES CONSTRUCTION, OPERATION AND MAINTENANCE 28

PUBLIC PARTICIPATION 28

ENFORCEMENT 29

VI. WATER POLLUTION SOURCES 31

MUNICIPAL AND INDUSTRIAL DISCHARGES 31

Gildford 35

Big Sandy 35

Rocky Boy Agency 35

Burlington Northern Engine Shop, Havre . . . 35

Havre Sewage Treatment Plant 36

Chinook Water Treatment Plant 36

Chinook Sewage Treatment Plant 37

Harlem Water Treatment Plant 37

Harlem Sewage Treatment Plant 37

Dodson 37

Malta 38

Saco 38

Hinsdale 38

Glasgow 38

Sunburst 39

Sweetgrass 39

AGRICULTURAL DISCHARGES 39

Strommen Hereford Ranch 40

Charles Schwenke Feedlot 40

Page

Krall Farms 42

Heavirland Farms 42

Hinsdale Livestock Company 42

Holman Hereford Home, Inc. 43

Vita Rich Dairy, Inc. 43

Seamons Dairy 43

Art Hauge, Turner 44

Treasure State Testing Station 44

Northern Montana Agricultural Research Center 44

MINING ACTIVITY 44

NON-POINT SOURCES 45

VII. SURFACE WATER RESOURCES 53

VIII. WATER QUALITY 63

MILK RIVER, NORTH FORK 68

MILK RIVER, ORIGIN AND FLOW INTO CANADA . . . 68

MILK RIVER FROM CANADA TO HAVRE 68

Big Sandy Creek 69

Beaver Creek 69

MILK RIVER FROM HAVRE TO COTTONWOOD CREEK . . 69

Lodge Creek and Battle Creek 70

Peoples Creek 70

MILK RIVER FROM COTTONWOOD CREEK TO ITS MOUTH AT THE MISSOURI RIVER 71

Frenchman River 71

Page

Beaver Creek 71

Porcupine Creek 72

IX. WASTE DISCHARGE PERMITS 75

X. WASTE LOAD ALLOCATIONS 81

XI. MANAGEMENT AND STRATEGY 83

XII. SURVEILLANCE PLAN 87

XIII. MUNICIPAL FACILITIES INVESTMENTS 91

XIV. PLANNING NEEDS 95

XV. MILK RIVER BASIN PUBLIC HEARING 97

APPENDIX 99

APPENDIX A. GLOSSARY 101

APPENDIX B. WATER QUALITY STANDARDS 103

APPENDIX C. SYSTEM FOR GEOGRAPHIC LOCATION OF FEATURES 115

REFERENCES 117

PLATE I. MAP OF MILK RIVER BASIN . . . . . Pocket

LIST OF TABLES

Table		Page
1.	WEATHER STATIONS IN THE MILK RIVER BASIN	11
2.	COMMUNITIES OF 100 OR MORE PEOPLE	21
3.	MILK RIVER BASIN POPULATION AND EMPLOYMENT, HISTORICAL AND PROJECTED 1930 - 1985	22
4.	CHARACTERISTICS OF SIGNIFICANT MUNICIPAL AND INDUSTRIAL DISCHARGES	32
5.	CHARACTERISTICS OF THE DOLL HOG FARM DISCHARGE	41
6.	NON-POINT SOURCE WATER ANALYSES RESULTS	46
7.	ACRES OF SALINE SEEP ON CROPLAND	47
8.	IRRIGATION RETURN FLOW WATER QUALITY	48
9.	WASTE DISCHARGE PERMIT APPLICATION FOR IRRIGATION ACTIVITIES	49
10.	WESTERN EQUINE ENCEPHALITIS DURING 1971 AND 1972	51
11.	NON-POINT SOURCE PROBLEM RANKING AND BENEFITS FROM CONTINUED WORK ON THE PROBLEM	52
12.	SUMMARY OF U. S. GEOLOGICAL SURVEY STREAMFLOW GAGING STATION DATA	56
13.	TYPICAL STREAM FLOW DATA FOR MILK RIVER BASIN (USGS Water Resources Data 1972)	60
14.	MILK RIVER USGS WATER QUALITY STATIONS	64
15.	MILK RIVER WATER QUALITY SUMMARY	66
16.	STREAMS AND CONDITIONS REQUIRING FURTHER STUDY	73

Table		Page
17.	MPDES PERMITS IN THE MILK RIVER BASIN . .	76
18.	MILK RIVER BASIN FEEDLOT PERMITS ISSUED .	78
19.	MILK RIVER WATER QUALITY SURVEILLANCE STATIONS	89
20.	MUNICIPAL SEWAGE TREATMENT NEEDS IN THE MILK RIVER BASIN	92

LIST OF FIGURES

Figure		Page
1.	SKETCH MAP SHOWING MILK RIVER BASIN . . .	3
2.	AVERAGE TEMPERATURES AND NORMAL PRECIPITATION FOR THE MILK RIVER BASIN .	13
3.	SCHEMATIC DIAGRAM OF STREAMS IN THE MILK RIVER BASIN	55

WATER QUALITY INVENTORY AND MANAGEMENT PLAN
MILK RIVER BASIN, MONTANA

I. INTRODUCTION

This report presents information related to water quality and water quality management in the Milk River basin (Figure 1). This basin is one of sixteen basins designated by the state of Montana for preparation of water quality management plans. The Federal Water Pollution Control Act Amendments of 1972 (P. L. 92-500) have directed states to prepare such plans as part of a national program for controlling water pollution.

The objectives of this effort are to provide the state with water quality data and related information to:

1. Determine the water quality characteristics of all natural and waste waters.

2. Determine what factors, both natural and man-made, affect the quality of waters in the basin.

3. Develop a management strategy for maintaining and enhancing the quality of waters in the basin.

4. Provide information needed to determine whether Montana's water quality standards are being and will continue to be met.

Also included is a description of physical characteristics of the basin. The general methodology used in this study was the compilation and evaluation of existing water quality data and related information. Where information was deficient, field investigations and water and wastewater sampling and analyses were completed to obtain the needed information.

This investigation does not present a detailed analysis of the area's resources but summarizes water quality related information. As additional information becomes available, the Milk River basin water quality management plan will be revised and updated as part of Montana's continuing planning process.

Assistance in obtaining information for this report was obtained from a number of agencies and persons. Special thanks for their assistance is given to Martha Dow, Havre area microbiologist and Frank Gjersing, regional game biologist, Havre, Montana. The Montana Department of Natural Resources and Conservation provided information on land use, water use, economy and population. The United States Geological Survey (USGS) personnel provided unpublished water quality data on stations maintained by the USGS. Federal waste discharge permit information was obtained from Richard T. Montgomery, U. S. Environmental Protection Agency state engineer for Montana.

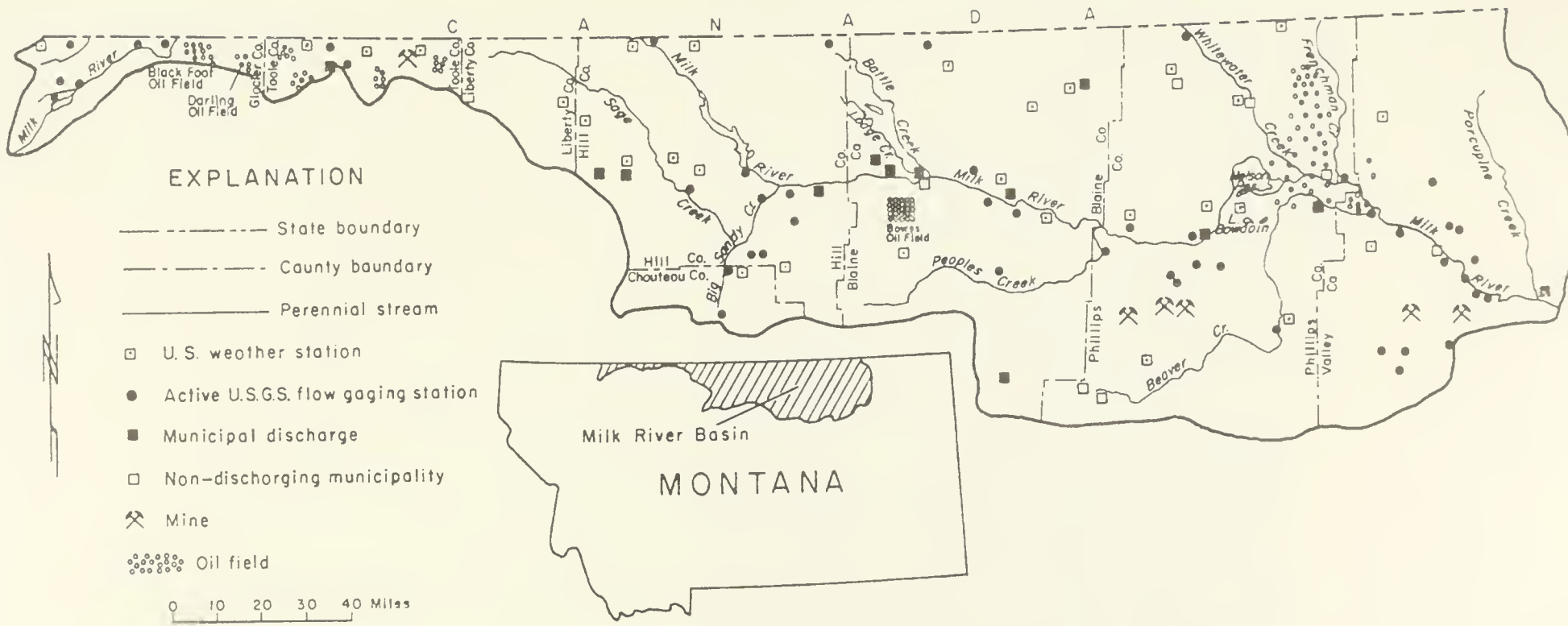


Figure 1 – Sketch map showing Milk River Basin.

II. SUMMARY AND CONCLUSIONS

Water quality of the Milk River drainage basin varies from clear mountain streams to heavily silt-laden, sluggish streams. There are 12 municipal, three agricultural, three water treatment plant discharges, and one industrial discharge in the Milk River basin. Permits have been issued or are pending under either the state or federal permit system for all discharges. Compliance schedules have been established for ten municipal discharges and secondary treatment is required of all municipal discharges by July 1, 1977. With the municipal improvements and when the improvements for the livestock-related operations are completed, it is anticipated that all water in the Milk River basin will meet state water quality standards.

Municipal facilities investments needed to achieve secondary levels of treatment for public sewage treatment facilities in the basin are estimated at approximately $2,186,000. Construction is nearly complete on the Havre secondary treatment facility. Several smaller communities in the basin need to upgrade sewage treatment facilities.

III. RELATED INVESTIGATIONS AND PLANS

TECHNICAL INVESTIGATIONS

A preliminary survey report on the feasibility of forming a NORTH CENTRAL WATER CONSERVANCY DISTRICT (Montana Water Resources Board, 1970), concludes that:

There is not enough water to fully develop the irrigation requirements of the study area and that under a conservancy district, multiple purposes, such as flood and erosion control, fish, wildlife and recreation aspects, should be included in the project planning.

Feasibility of irrigating land between Tiber Reservoir and Havre as well as augmenting Milk River flow with Marias River water was discussed by the U. S. Bureau of Reclamation (1970). This report was written in an attempt to justify water use from Tiber Reservoir for irrigation. The report shows that the plan is economically feasible.

Zimmerman (1967) completed a study of the surface water and groundwater resources of Glacier and Toole counties and concluded that groundwater from the Virgelle Sandstone and the Two Medicine Formation and surface water from Cut Bank Creek are the only dependable sources of fresh water in the Cut Bank area. He also concluded that depletion of fresh groundwater supplies in the Virgelle is not eminent. Hopkins and Taylor (1962) concluded that groundwater in the Milk River unit of the Fort Belknap Indian Reservation occurs in the Judith River formation, in sand and gravel underlying the Milk River flood plain, in glacial outwash deposits and in silty and sandy strata within the flood plain deposits. They state that water in most aquifers is under artesian pressure. Zimmerman (1960), in a study of groundwater in northeastern Blaine County, Montana, concluded that there are large supplies of good quality water available from the Flaxville Formation underlying the Big Flat north of Harlem. He estimated 300,000 acre-feet of groundwater in storage and a 5,000 acre-feet available recharge.

Saline seep studies are being conducted by different governmental agencies to determine the severity of this problem. The Soil Conservation Service is presently, on

a county basis, mapping the saline seep areas and in Toole County is experimenting with different types of grasses that will grow in saline soils. In Daniels County, SCS personnel plan to use a conductivity bridge to determine the extent and possible sources of saline waters. John Duke, working for the State Lands Department, is investigating the historical significance of saline seeps and is assembling a comprehensive map of the saline seep areas.

Other geological and hydrologic investigations that include this basin are Stanton and Hatcher (1905), Calhoun (1960), Pepperberg (1910), Perry (1934), Knechtel (1942, 1959), Zimmerman (1960), D. G. Frickel (1972), D. C. Alverson (1965), Montana Department of Health (1935-1945), A. J. Collier and W. J. Tom, Jr. (1917), W. C. Alden (1932), Meyboom (1960), and S. Tebinger (1917).

AREAWIDE WASTE TREATMENT MANAGEMENT PLANS

There are no areawide waste treatment management plans in the Milk River basin under Section 208 of the Federal Water Pollution Control Act Amendments of 1972. None are anticipated in the next five years.

SECTION 201 FACILITY PLANS

No wastewater facility plans have been completed for any municipalities in the Milk River basin. Any sewage treatment facility construction grants awarded after July 1, 1974, will require, under the present federal grant program, a facility plan to be written by the municipality or its consulting engineers.

LEVEL B PLANS AND OTHER FEDERAL PLANS

The preliminary survey report, NORTH CENTRAL WATER CONSERVANCY DISTRICT, covers both the Marias and Milk River basin watersheds, and information from various portions of this report is used throughout this plan. This plan (Henningson, Durham & Richardson, 1970) is similar to a Level B plan; however, a Level B plan is anticipated to be completed by the Department of Natural Resources by 1978. Type IV planning in Montana is administered by the U. S. Department of Agriculture. Type IV planning has not been initiated for the Milk River basin.

IV. BASIN PHYSICAL CHARACTERISTICS

The Milk River basin (Figure 1 and Plate I) includes the Milk River drainage originating in Glacier National Park and extends to the western international crossing of the Milk River into Canada.

The Milk River again enters the United States at the international crossing and extends eastward to the confluence of the Milk River and the Missouri River below Fort Peck Dam. The basin includes approximately 77 percent of Blaine County, 11 percent of Chouteau County, 17 percent of Glacier County, 91 percent of Hill County, 27 percent of Liberty County, 72 percent of Phillips County, 15 percent of Toole County, 66 percent of Valley County and has a total area of approximately 14,984 square miles. Topography in the basin varies from altitudes of 7,000 feet in peaks of the Sweetgrass Hills, located in northern Toole County, to 2,000 feet in bottom lands in eastern Valley County.

There are 12 municipal waste discharges, one industrial waste discharge, three water treatment plant discharges, three agricultural discharges, 44 water quality monitoring stations, 13 stream flow gaging stations, and 35 weather stations in the basin (Plate I). Most of the waters in the basin have been classified as B-D3 by the state of Montana.

The Milk River drainage from its source (or from Glacier National Park boundary) to the international boundary, Big Sandy Creek drainage above Big Sandy, Beaver, Box Elder, and Clear Creek drainages (all near Havre) and Peoples Creek drainage to and including the South Fork of Peoples Creek are classified as B-D1. B-D1 waters are to be maintained suitable for drinking, culinary, and food processing purposes after adequate treatment equal to coagulation, sedimentation, filtration, disinfection, and any additional treatment necessary to remove naturally present impurities; bathing, swimming and recreation; growth and propagation of salmonoid fishes and associated aquatic life, waterfowl and furbearers; agricultural and industrial water supplies. Detailed water quality criteria for all water in the basin are shown in Appendix B.

The Milk River between Havre and Chinook is classified by the state of Montana as water quality limited. When this portion of the river was classified as water quality limited, the river was high in turbidity and sediment due to poor land conservation practices and erosive soils present in the area. The river was also high in coliforms due to municipal discharges and feedlots. Since this classification, the number of feedlots has been reduced and municipal facilities have been upgraded. Limited data obtained during this investigation suggests that this segment of the river now meets state water quality standards. This segment will continue to be classified as water quality limited until confirming data are obtained to reclassify the segment.

Based on samples collected during this study, the Milk River below Hinsdale should have more work done to determine if this segment of the river meets state water quality standards.

CLIMATE

Greatly varying topography plays a large part in the basin's climate pattern. Winter chinook winds are prevalent in Glacier, Pondera, Chouteau, Liberty, and Toole counties. Following arctic cold fronts, these chinook winds often raise temperatures from below zero degrees Fahrenheit to above freezing in a very short time. Hill, Blaine, Phillips, and Valley counties typically have a continental type climate of cold, dry winters; cool, moist springs; and warm summers. Hill, Chouteau and Blaine counties are the transition counties and have both the chinook and continental type of climate.

The mean annual precipitation in the basin is approximately 12 inches, most of which falls during June, July and August. Mean minimum temperatures for January in the Milk River basin lie within the zero to eight degrees Farenheit isotherms. The lowest recorded temperature was -57° F in January, 1916, while the highest recorded temperature was 111° F in August, 1961 as reported in CLIMATE OF MONTANA (1971).

Operating weather stations in the basin are listed in Table 1. The Havre station is maintained by the National Oceanographic and Atmospheric Administration (NOAA). All other stations listed are maintained by private individuals, private industry, or other governmental agencies under cooperative agreement with NOAA. Basin weather can be characterized by data collected

at Havre. Normal monthly temperatures and precipitation for Havre from 1931 - 1960 are shown in Figure 2.

TABLE 1. WEATHER STATIONS IN THE MILK RIVER BASIN

Station	Location Lat.	Long.	County	Temp.	Precip.	Gaging	Record Years
Baylor	4840	10629	Valley		X	Recording	
Big Sandy	4810	11007	Chouteau	X	X	Nonrecording	
Chinook	4835	10914	Blaine	X	X	Nonrecording	13
Cleveland	4819	10904	Blaine	X	X	Nonrecording	
Content	4759	10734	Phillips	X	X	Both types	
Del Bonita	4900	11247	Glacier	X	X	Nonrecording	
Dodson	4824	10815	Phillips		X	Nonrecording	10
Dodson 11N	4833	10812	Phillips		X	Recording	
Ethridge	4834	11208	Toole		X	Nonrecording	12
Forks 4 NNE	4847	10728	Phillips	X	X	Nonrecording	11
Ft. Assinni-boine	4830	10948	Hill	X	X	Nonrecording	12
Gildford 1S	4833	11018	Hill	X	X	Nonrecording	
Glasgow 15NW	4823	10650	Valley		X	Nonrecording	10
Glasgow WSO AP	4813	10637	Valley	X	X	Both types	8
Gold Butte 7N	4859	11124	Toole	X	X	Nonrecording	13
Harb	4811	10726	Phillips		X	Nonrecording	10
Harlem	4832	10847	Blaine	X	X	Nonrecording	12
Havre WSO AP	4833	10946	Hill	X	X	Both	12
Hingham	4833	11026	Hill		X	Nonrecording	12
Hinsdale 4SW	4821	10709	Valley	X	X	Nonrecording	10
Hinsdale 23N	4845	10705	Valley	X	X	Nonrecording	12
Hogeland 7 WSW	4849	10848	Blaine	X	X	Nonrecording	12
Joplin 1N	4835	11047	Liberty	X	X	Both types	11
Kremlin	4835	11005	Hill		X	Nonrecording	
Loring 10N	4857	10749	Phillips	X	X	Nonrecording	12
Malta 7E	4824	10744	Phillips	X	X	Nonrecording	13
Opheim	4900	10744	Phillips	X	X	Nonrecording	12
Phillips 1S	4804	10810	Phillips	X	X	Nonrecording	15
Rocky Boy	4815	10947	Hill		X	Nonrecording	18
Rudyard 30N	4859	11035	Hill	X	X	Nonrecording	

Station	Location		County	Temp.	Precip.	Gaging	Record Years
	Lat.	Long.					
Saco 1NNW	4828	10721	Phillips	X	X	Nonrecording	9
Santa Rita 17N	4857	11218	Glacier	X	X	Nonrecording	13
Simpson 6NW	4859	11019	Hill	X	X	Nonrecording	10
Sunburst 8E	4854	11144	Toole		X	Nonrecording	13
Sweetgrass	4900	11157	Toole	X	X	Nonrecording	
Turner	4851	10824	Blaine	X	X	Nonrecording	12
White Water	4846	10738	Phillips		X	Nonrecording	9

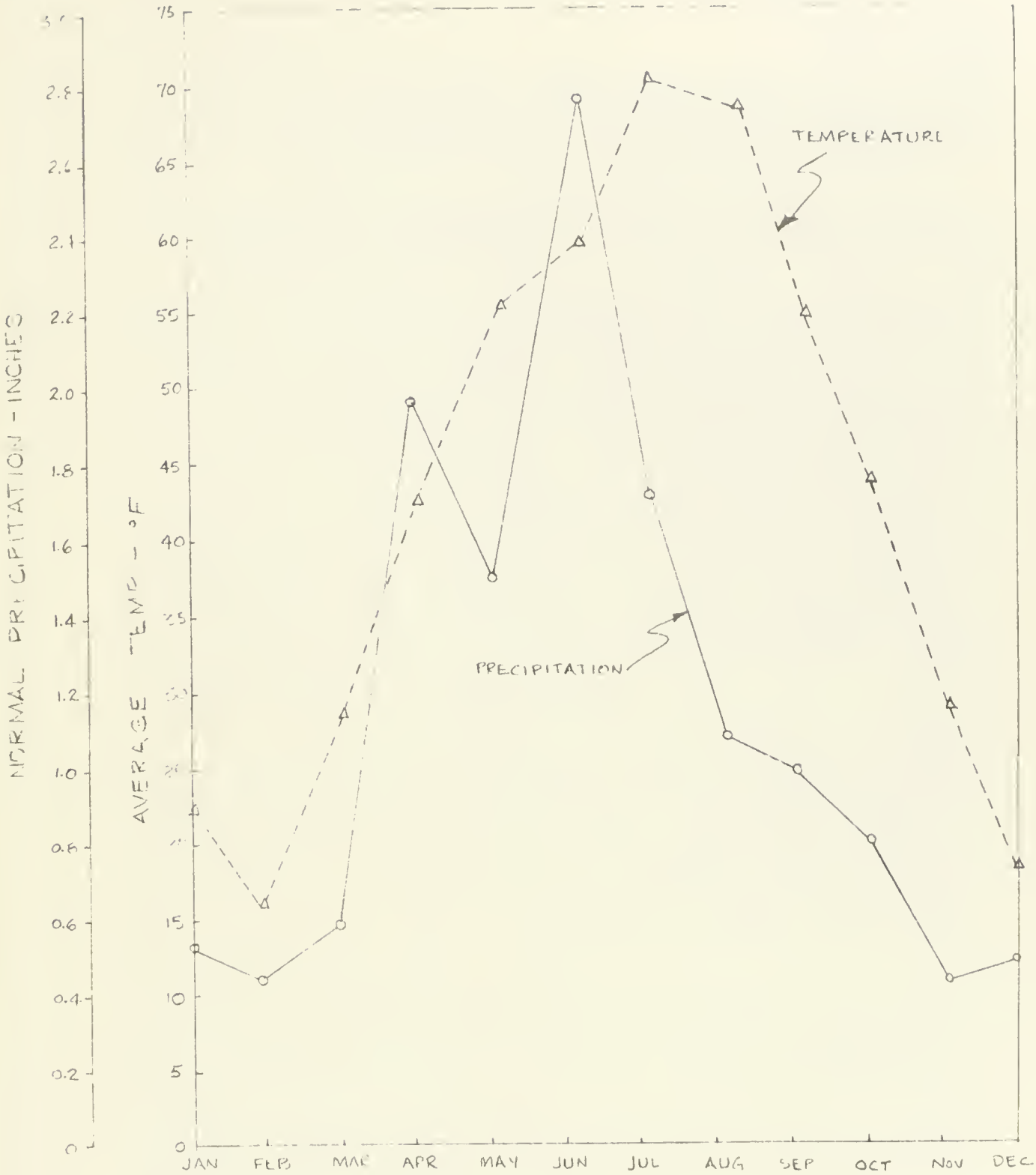


FIGURE 2. AVERAGE TEMPERATURES AND NORMAL PRECIPITATION FOR THE MILK RIVER BASIN (Based on NOAA data for Havre, Montana)

HYDROGEOLOGY

Groundwater is widely available in the Milk River basin and is used for stock, domestic, irrigation, and municipal purposes. Availability of groundwater in the basin is closely related to geological conditions.

A wide variety of geological formations, ranging in age from Cambrian to Recent, are present in the Milk River basin. Geological history of the area includes long periods of sedimentation and erosion punctuated by uplift and structural deformation. After deposition of a thick sequence of sedimentary rock, a series of broad uplifts were formed creating arches and domes that subsequently have been eroded. Erosions of these features removed many overlying sedimentary layers, thereby bringing older and normally more deeply buried sedimentary rocks closer to the ground surface. In the portion of the Milk River drainage in Hill County and eastward from Hill County, bedrock formations of Cretaceous (65 to 135 million years old) include the Hell Creek Formation, Fox Hills Sandstone, Judith River Formations, Eagle Sandstone Formations, Bearpaw Shale, Claggett Shale, Telegraph Creek Formation, and Colorado Group. The Judith River Formation is particularly widespread in western and central portions of the Milk River basin and is an important aquifer (water-bearing) formation. Sandstone aquifers in the Milk River basin generally contain small to moderate quantities of fair to poor quality water and are widely used sources of domestic and stock water. Bedrock formations composed of shale, including the Bearpaw Shale, Claggett Shale, and the Colorado Group are essentially nonwater-bearing. Shale formations occur throughout the basin with the Bearpaw Shale particularly abundant in the northern and eastern portions of the basin.

With the exception of mountainous portions of the basin, bedrock formations are encountered directly beneath the glacial till, which is derived from continental glaciers that covered the area during the Pleistocene epoch (10,000 to 1,000,000 years ago). Glacial deposits include ground and terminal moraines and outwash channel deposits. Morainal deposits consist of compacted mixtures of boulder, sand, gravel, silt and clay that range in thickness from a few feet to as much as several hundred feet in ancient buried valleys. These deposits generally yield small quantities of water to wells but water quality often is unsuitable for domestic use. Outwash channel deposits derived from erosion of the glacial deposits will yield

moderate to occasionally large quantities of fair quality water.

In addition to bedrock and glacial deposits, there are scattered terrace deposits of Tertiary age in the basin. Along the Milk River and its large tributaries in the basin are Recent alluvial deposits that contain groundwater. Alluvium along the Milk River consists of sand, silt and clay that thinly cover older glacial deposits. Water quality is generally poor in this shallow alluvium, and water yields are not good.

The headwater portion of the Milk River basin is in Montana in northern Glacier County. Bedrock formations in this area are predominantly sedimentary rocks of Cretaceous age. These rocks generally yield small to moderate quantities of fair to good quality water to wells. There are some areas of Tertiary and Quarternary alluvium and glacial deposits. All these deposits can yield water to wells. Glacial deposits in the area are derived from large glaciers that advanced eastward from the mountains of western Glacier County to cover large areas in the northwestern and southwestern parts of the basin. These deposits are composed of a mixture of boulder, gravels, sand, silt and clay. There are few wells in these deposits, but general geological conditions suggest that these deposits would yield small to moderate quantities of water to wells.

Scattered terrace deposits of Tertiary or Quaternary age consisting of unconsolidated gravels are found along the mountain front. These deposits cover small areas and are remnants of ancient stream deposits. Along the major streams in this portion of the Milk River basin are small deposits of unconsolidated sand, gravel, silt and clay. These deposits are Recent in age (less than 20,000 years old) and are the result of reworking of older deposits. Small to moderate amounts of groundwater are present in these deposits.

A number of groundwater pollution problems have been identified with the basin. Saline seeps are created when precipitation infiltrates into salt-laden earth materials, thereby dissolving salt and redepositing the salt in areas of groundwater discharge. This is a serious problem in Montana and a number of saline seeps have been identified in the basin. Sewage stabilization lagoons generally have seepage into the groundwater and create localized areas of groundwater pollution; however, there have been no problems due to lagoon seepage reported for the basin. There are approximately 13 sewage lagoons in the basin.

Waste from septic tanks can create localized areas of groundwater pollution. Where there are a number of septic tanks and individual water supplies using wells, groundwater pollution can lead to public health problems if disposal systems are not properly designed and located. Direct discharge of septic tank effluents or drainfield effluents to streams and cutoff oxbows of rivers have been identified in the basin, particularly in Blaine County. This can create water pollution problems. A number of feedlots exist in the basin, and it is expected that seepage into the groundwater will occur beneath the feedlots and will create localized areas of groundwater pollution. There has been a report of petroleum product contamination of groundwater about ten miles west of Sweetgrass, Montana. This area has not been examined in detail.

SOILS

The major geologic event that influenced soils of the Milk River basin was the advance and recession of continental glaciers. Soils are generally underlain by glacial till, unsorted, nonstratified material carried or deposited by glaciers. Fine materials, silt and clay were often deposited in bodies of still water. Extensive sedimentation over long periods of time has resulted in the filling of many stream valleys with alluvium. The primary non-glaciated areas in the river basin are the Little Rocky Mountains, Bearpaw Mountains, and upper slopes of the Sweet Grass Hills. Underlying rock exposed in places consist of alternating beds of shales and sandstone. Bearpaw Shale, Judith River Sandstone, and Claggett Shale are exposed in sufficiently large areas to form soils.

Dominating much of the undulating to nearly level glacial plains north of the Milk River are soils characterized by a gray, loose, structureless, defloculated surface layer; an underlying grayish-brown layer in which the material is slightly more coherent than in the surface layer; a heavy columnar clay or solenetz (soils with abnormally high salt concentrations dominated by sodium); and a zone of carbonate accumulation underlain by parent material, which, in most places, is glacial till. The highly alkaline layer restricts plant growth giving areas dominated by these soils a desolate appearance characterized by a surface having 20 to 60 percent bare spots known as "Slick spots" or "blowouts". These soils have poor drainage and a high erosion hazard. These soils are

used for livestock grazing and to a limited extent dryland grain production. In general, they should not be considered for irrigated crop production.

The exception to the general glaciated pattern north of the Milk River is an area known as the "Big Flat". The "Big Flat" north of Harlem is a large, relatively flat portion of the plain. The well developed loamy textured soils overlay clay loam glacial till, which is underlain by gravel and sand. This indicates that the glacial deposits are situated over high terrace gravels. The general terrain is split by two large and several small glacial melt water valleys. The soils of the broad valleys are either sandy or loamy textured underlain by loose sands and gravels at depths of 20 to 30 inches. The soils of the "Big Flat" present slight to moderate erosion hazards and are generally used for dryland grain production.

The northwest section of the Milk River basin in Montana is dominated by well-drained, deep, dark-colored clay loam soils on nearly level to rolling glacial till plains. They present slight to moderate erosion hazards and are used for dryland grain production and rangeland. The undulating and rolling glacial till plains south of the Milk River are dominated by loam to clay-loam soils underlain by calcareous glacial drift. They present moderate erosion hazards and are used for rangeland with some dryland grain production.

In the eastern section of the Milk River basin, flats overlain by thin glacial drift and gentle colluvial slopes have developed a silty-clay soil with a massive calcareous clay subsoil, which grades into a highly calcareous silty-clay loam. The substratum is a dark gray, silty clay streaked and flected with salt accumulations. Although these soils are heavy and difficult to work, they are an important non-irrigated agricultural soil, but due to poor drainage and rapid runoff, present a severe erosion hazard.

Similar soils have developed on terraces and colluvial slopes within or bordering exposures of shale. They are sticky when wet and hard when dry. In some areas, coarse to moderately coarse sediment have been deposited with the shale erosion material. In such areas, limited dryland agriculture is possible, but the majority of these soils are used as rangeland. As expected, they have an extreme erosion potential.

Soils developed on recent alluvium that have been derived from shale parent material, mostly in the Milk River valley, are usually extremely heavy in texture (clay). They are plastic and sticky when wet, drainage is slow, and the erosion hazard extreme. These clay soils are locally termed "gumbo" and present severe problems with respect to agricultural production. Deep rooted legumes, such as alfalfa, have been used in some areas to improve soil texture.

Some soils developed on recent alluvium have a loam or fine sandy loam topsoil underlain by stratified layers of different grades of Calcareous sands. When these soils border areas of heavy clay soils, a clay layer has developed at a depth ranging from 18 to 24 inches below the surface. In general, because of the excellent physical characteristics of this soil, it is easily worked, holds moisture well, and warms up early in the spring. It is, therefore, an especially desirable soil for irrigated crop production. It presents slight to moderate erosion hazards.

In the Little Rocky Mountains, loamy soils 10 to 20 inches deep, have developed on the steep slopes. Limestone outcrops are also evident. The Bearpaw Mountains are dominated by shallow, heavy textured soils over clay. They can present a severe erosion hazard under conditions of disturbance or overgrazing. In the area of the Sweetgrass Hills, the soils are shallow on the steep slopes. In the stream valleys originating from these mountains, deep loamy soils have developed that are generally low in salinity.

Sections of the Milk River and Beaver Creek valleys are bordered by rough, steeply eroded escarpments. This rough, broken land includes three classes of soil material--glacial till, residual shale and residual sandstone. Whenever glacial material covers underlying shale and sandstone formations, better vegetation exists. These lands are all untillable and are used only for livestock grazing and present an extremely severe erosion hazard.

The Havre Badlands on the north side of the Milk River near Havre is one of these rough, steeply eroded escarpments. Recent erosion has washed highly alkaline silts and clays into the river deposited alluvial areas, rendering the affected areas impractical for agriculture.

LAND USE

The largest land use within the Milk River basin is privately owned range land. This use constitutes approximately 45.1 percent of the total basin. The next largest use classification is federal non-crop, which includes all federal lands in the basin that are not being farmed. This classification accounts for 27.9 percent of the land area, and it can be assumed that the majority of this land is being used as range land. The other major land uses within the basin are as follows:

Cropland - 22.9 percent
Pasture - 1.3 percent
Forest - 1.3 percent
Urban and municipal areas - 0.8 percent
Small water areas of less than 40 surface acres - 0.2 percent

The remaining portion of the basin, or 0.5 percent, is considered as unusable. An example of this type of area would be rock outcrops.

Irrigated lands account for 238,380 acres of the basin. This land would fall in both the cropland and the pasture categories. Primary irrigated crops grown are hay for forage and pasture for grazing. Grains and hay are the major dryland crops in the basin.

The entire Rocky Boy Indian Reservation, as well as parts of the Blackfeet, Fort Belknap, and Fort Peck Reservations, are located within the basin.

WATER USE

The largest water user in the basin is irrigation. Total water diverted for this use is approximately 1,422,800 acre feet annually. Of this figure, 995,945 acre feet is delivered to the farm, and 348,580 acre feet are consumptively used by the crops. Return flows are approximately 751,940 acre feet, and the total depletion figure is 670,860 acre feet. These figures are all approximate and are based on 70 percent delivery system efficiency and a 35 percent farm efficiency.

Municipal water use in the basin accounts for 4,098 acre feet annually. Of this total, seven cities depend on groundwater supplies and use 1,224 acre feet per year. Eleven cities are totally dependent on surface water and

use 1,433 acre feet annually. Havre draws from both sources and supplies approximately 5.980 acre feet per year. It is estimated that other communities with a population of 25 or more and that do not have municipal supply systems consume approximately 2.5 additional acre feet per year.

Other water usage in the basin; that is, industrial and stock water, is negligible.

POPULATION AND ECONOMY

The Milk River basin encompasses much of the northern string of counties known in Montana as the highline. The basin includes most of Phillips, Blaine, Valley and Hill counties, and parts of Glacier, Toole, Liberty, and Chouteau counties. For this profile, 1970 census data from county census divisions have been summed to approximate the population and employment of the basin. According to the 1970 census, 62 percent of the population is classed as rural. The census considered Glasgow and Havre as the only urban areas in the basin.

Communities in the Milk River basin with 100 or more people are listed in Table 2 along with their 1970 population. Table 3 contains historical and projected population and employment. Although neither population nor total employment has been regular in their changes, they have been relatively stable. The year 1960 is the exception, with the Glasgow Air Base being a major factor. By sectors, several apparent trends are evident. Agricultural employment, although of singular importance to the basin's economic base, has exhibited a steady decline, dropping over 60 percent from 1930 to 1970. Construction has been erratic, manufacturing has climbed since 1950, and services (which include government) has grown to play a major role.

As mentioned, agriculture is still the number one element in the basin's economic base. Much of the area is noted for its dryland grain production. Cash receipts from crops outweigh those from livestock for the basin as a whole, although livestock receipts are larger in Blaine and Phillips counties.

Population and total employment are projected to remain near their present levels to 1985, although the employment mix may continue to change. It is worth noting that there are oil, natural gas, and coal deposits in the

basin. A substantial increase in exploration, production, processing and transportation of these mineral fuels could invalidate the projections.

TABLE 2. COMMUNITIES OF 100 OR MORE PEOPLE

Community	County	1970 Population
Chinook	Blaine	1,813
Fort Belknap Agency	Blaine	200
Harlem	Blaine	1,094
Turner	Blaine	150
Zurich	Blaine	200
Big Sandy	Chouteau	827
Box Elder	Hill	120
Gildford	Hill	300
Havre	Hill	10,558
Hingham	Hill	262
Kremlin	Hill	190
Rocky Boy	Hill	175
Rudyard	Hill	600
Dodson	Phillips	196
Malta	Phillips	2,195
Saco	Phillips	356
Whitewater	Phillips	100
Sunburst	Toole	604
Sweetgrass	Toole	150
Glasgow	Valley	4,700
Hinsdale	Valley	390
Nashua	Valley	513

TABLE 3. MILK RIVER BASIN POPULATION AND EMPLOYMENT, HISTORICAL AND PROJECTED 1930 - 1985

	1930	1940	1950	1960	1970	1980	1985
Population	41,476	44,286	39,922	48,211	40,114	42,969	43,019
Employment Total	16,445	14,252	15,040	15,974	14,404	14,503	14,346
Agriculture	8,930	6,079	5,567	4,215	3,226	---	---
Forestry and Fisheries	10	10	4	3	0	---	---
Mining	327	325	183	60	110	---	---
Construction	495	932	1,001	1,475	680	---	---
Manufacturing	749	386	384	467	686	---	---
Services and Other	5,934	6,520	7,911	9,754	9,702	---	---

BIOLOGICAL CONDITIONS

The Milk River drainage contains a wide variety of fish species. Salmonoids are found in tributaries in the upper drainage near the Continental Divide and in several streams draining the Bearpaw Mountains south of Havre. Salmonoid species include brook trout, rainbow trout, cutthroat trout and brown trout. Rainbow trout are also found in several ponds, lakes and reservoirs throughout the drainage.

Other important game fish and sport fish species found in lower portions of the drainage include northern pike, walleye, sauger, largemouth bass, paddlefish, yellow perch, bluegill, black crappie, white crappie, channel catfish, black bullhead and burbot. Fish of commercial value taken mostly from reservoirs in the drainage include smallmouth buffalo, bigmouth buffalo, goldeye, carp, river carpsucker and white sucker (Needham, 1974), although at least 42 species of fish are known to inhabit waters of the Milk River drainage (Brown, 1971).

Changes in water quality greatly affect fish species distribution in the drainage. Salmonoids are found mainly in the cool mountain streams and in ponds and reservoirs deep enough to provide adequate cool water in the summer and sufficient oxygen in the winter. Non-salmonoid fishes have a wider tolerance relating to water temperatures, dissolved oxygen and sediment.

Sediment is probably the greatest factor affecting aquatic life in the Milk River drainage. For example, Fresno Reservoir, an irrigation impoundment on the Milk River west of Havre, acts as a settling basin and improves water quality in the river for several miles below the dam. Some trout are found in the section of river below the dam. The river again rapidly picks up a heavy sediment load from irrigation returns, tributary streams, and bank erosion before its confluence with the Missouri River near Fort Peck.

The Milk River and the associated Milk River tribuaries in this basin also contain beaver, muskrat and mink. To date, no known studies have been conducted to determine the effects of water quality on the propagation of these animals. Practices, such as vegetation control and overgrazing to the extent of damaging stream bank vegetation, would, however, have their effects on the available food and cover for these animals.

Mosquitos have consistently been a problem in the Milk River basin. Approximately 75 years ago, potential production from irrigation in the Milk River valley was realized, and the first efforts to divert water from the main channel were begun. During the ensuring years, several irrigation districts were formed and over 200,000 acres have come under irrigation. Due to a number of factors, including topography, soil structure, financial problems, and irrigation practices, the efficiency of irrigation on these lands has been less than anticipated and a natural habitat favorable to mosquito breeding has been created.

Over the years, the mosquito problem has increased in severity, but little or no effort has been expended to control their numbers. A study was commissioned in 1952 by the U. S. Public Health Service, which identified the problem areas and made recommendations to correct the problem. However, it was not until 1972, twenty years later, that an organized mosquito control district was formed and some effort was made to control mosquitos.

Over 90 percent of mosquito production is related to the type of irrigation practiced in the valley, thus control efforts must be directed towards eliminating the breeding areas or treating the breeding areas with chemicals. Much of the fresh water left standing in the field, laterals, ditches, and wastewater ponds is a result of excessive application or irrigation of unimproved land. Many drains are heavily choked with vegetation and water movement is sluggish. For the past three summers, mosquito abatement districts, both in Blaine and Phillips counties, have been applying organo-phosphate poisons and mosquito larvaciding oils in an effort to control the horrendous number of mosquitos associated with the irrigation cycle in the Milk River valley.

There is speculation that chemical and oil application deteriorate the natural habitat, the water, and is environmentally unsound (Ivey, 1974), but mosquitos can be a health problem and definitely contribute to the discomfort of the residents and livestock of the area.

V. MONTANA WATER POLLUTION CONTROL PROGRAM

Water quality management planning is part of a broad comprehensive water pollution control program administered by the Water Quality Bureau of the Environmental Sciences Division. This program is described in the program plan of the Water Quality Bureau (1974). Important elements of the state program are:

1. State and federal waste discharge permit program.
2. Water quality standards.
3. Facilities construction grants, plan review, operation and maintenance inspection, training, and licensing of operators.
4. Statewide monitoring and surveillance program.
5. Public participation.
6. Enforcement.

STATE AND FEDERAL WASTE DISCHARGE PERMIT PROGRAM

The 1955 Montana state law established a waste discharge permit program. A revision of this law in 1967 required a permit for all discharges. Regulations and a formal state permit program were established in 1968 for the discharge of sanitary sewage and municipal wastes to waters of the state. In 1972, a waste discharge permit regulation for confined livestock feeding was adopted by the Board of Health and Environmental Sciences. All operations feeding livestock for marketing purposes within any confined area or enclosure not normally used for raising crops or for pasture, which at any time discharges drainage water to a state water, is required to have a permit. Existing operations were required to have a permit before June 24, 1974. All new or expanding operations are required to have a permit.

The Federal Water Pollution Control Act Amendments of 1972 established a national permit system. Industrial, municipal, and other point source discharges will be required to obtain permits to discharge pollutants into navigable

waters or their tributaries. The EPA (U. S. Environmental Protection Agency) has given authority to allow states to administer the permit program provided the states conform to certain guidelines. On June 11, 1974, Montana assumed most of the federal permit program.

Waste discharge permits are an effective tool for regulating discharge of potentially harmful effluents into Montana lakes and streams. Treatment works will be required to meet specific effluent standards. In most instances, the discharger will be responsible for certain monitoring information; for example, sampling and analysis of the water at specified intervals. In instances where effluent being discharged does not meet state standards, the permit is issued on a "compliance" basis with stipulations as to what corrections will be made and when.

The act also provides that the permit program will achieve, not later than July 1, 1977, effluent limitations for point sources, other than publicly owned treatment works, which shall require the application of best practicable control technology. For publicly owned treatment works, secondary treatment of wastes or any more stringent limitation necessary to meet water quality standards will be required by July 1, 1977. The act further specifies that by July 1, 1983, effluent limitations for point sources, other than publicly owned treatment works, shall require application of the best available technology. Publicly owned treatment works shall achieve best practicable treatment by July 1, 1983.

These steps will result in progress toward a national goal of eliminating the discharge of all pollutants by 1985.

WATER QUALITY STANDARDS

Water pollution control was started officially in Montana in 1907 with the passage of legislation designed to protect domestic water supplies. A law passed in 1955 was more comprehensive. It dealt with the control and protection of water for additional uses--recreation, agriculture, and industry. The law also established a Water Pollution Control Council and charged it with the tasks of classifying all streams in the state according to their most beneficial uses and establishing water quality criteria for the streams. It also involved upgrading the treatment of wastes going into the streams. Montana, thus, became one of the first states to have enforceable stream classifications.

In 1965, the U. S. Congress passed the Federal Water Quality Act, which required that all states classify and establish water quality criteria for their interstate streams by July 1, 1967. This resulted in Montana revising its standards for both interstate and intrastate waters and required a higher degree of stream quality than before. Secondary treatment or the equivalent was required of municipal and industrial discharges. Primary treatment or equivalent was required before passage of the act.

In October, 1972, the Federal Water Pollution Control Act Amendments were passed by Congress expanding the authority of the Environmental Protection Agency. Uniform water quality standards and enforcement procedures throughout the United States is the objective. For example, industrial waste dischargers throughout the nation manufacturing the same product will have uniform discharge requirements, based on the amount of product produced. Again, Montana was required to revise its water quality standards. The Department of Health and Environmental Sciences adopted revised standards on July 13, 1973. The new standards became effective in November, 1973.

Other point sources covered by these amendments include certain animal confinement facilities and irrigation activities. The owner or operator of any animal confinement facility which holds, or during the previous 12 months held, for a total of 30 days or more 1,000 or more animal units must make application for a waste discharge permit. The owner or operator of a drainage system serving 3,000 or more irrigated acres must likewise make application for a waste discharge permit.

The Montana Pollutant Discharge Elimination System rule extends the permit requirement to cover any animal confinement facility which could discharge pollutants to state waters.

Montana water quality standards serve as a functional tool in protecting water quality; however, there are a number of laws, statutes and regulations which complement the water quality standards and significantly assist in protecting water quality.

STATEWIDE MONITORING AND SURVEILLANCE PROGRAM

Prior to 1972, Montana had done little monitoring due to lack of funds. With increased appropriations provided by the 1971 legislature and the federal government, the state greatly increased its efforts. Staff were added and laboratory equipment purchased. The present state monitoring program includes periodic compliance monitoring of municipal and industrial wastes, long-term baseline monitoring of streams, and a statewide program for determining the general quality of all significant surface waters.

The statewide inventory of water quality will identify areas with water quality problems and will provide basic data for water quality management and planning programs. Included in the monitoring is a statewide assessment of the trophic (pollution level) status of Montana's lakes, reservoirs and ponds. This program is coordinated with the EPA National Eutrophication Survey.

FACILITIES CONSTRUCTION, OPERATION AND MAINTENANCE

A minimum requirement of primary treatment for all domestic sewage was first adopted by the Montana Board of Health in 1952. All of Montana's communities have met this requirement, and many of the communities are upgrading their facilities to secondary treatment or are in the process of constructing or planning secondary systems. Since 1956, there has been a federal grant program to assist municipalities in the construction of sewage treatment facilities, including outfall and interceptor sewers. In 1971, the Montana state legislature appropriated $4,000,000 to aid municipalities in construction of these same facilities. The 1973 legislature appropriated $1,600,000 to reimburse municipalities that had proceeded with construction since July 1, 1966, without waiting for state grants. With passage of the Federal Water Pollution Control Act Amendments of 1972, 75 percent of eligible project costs are federally financed. Due to a shortage of federal grant funds, a priority system for fund allocation must be used. The state, under EPA guidance, establishes priorities for proposed waste treatment projects.

An important part of municipal sewage treatment is proper operation and maintenance of facilities after construction is completed. In an effort to improve operation and maintenance, the state has conducted an operators' school each year. During recent years, this school has had about 100 operators attending. In 1971, a grant was obtained from the federal government for employing two training instructors to establish training programs throughout the state in addition to the annual school.

An operators certification program was established in 1968 following enactment of a law requiring certification of those in responsible charge of a sewage treatment or industrial waste treatment system.

PUBLIC PARTICIPATION

Public participation in water pollution control is an increasingly important aspect of the state program. Public hearings are held concerning proposed regulations, water quality

management plans, and waste discharge permit applications. The state also has an environmental impact statement requirement. These statements are presented to the public for comment, and hearings are conducted on highly controversial issues.

The public is also kept informed by means of a Water Pollution Control Advisory Council, which has been established by law to assist the Water Quality Bureau in preparation of rules and regulations and in dissemination of information to interested groups. Similarly, public meetings are attended on request, and a bi-monthly newsletter is published by the Water Quality Bureau.

ENFORCEMENT

The 1955 Montana state law provided enforcement procedures. These laws were revised in 1971 to provide better enforcement, and an attorney was added to the staff of the department to aid in enforcement. The state permit system provides a primary means for enforcement. Violators of permit conditions or discharges without a permit can lead to enforcement.

VI. WATER POLLUTION SOURCES

Water pollution in the Milk River basin is caused by several factors, including municipal and industrial discharges, acid mine drainage from inactive mines, runoff from mismanaged and erodible soils, and agricultural wastewaters. Characteristics of significant municipal and industrial discharges are summarized in Table 4.

MUNICIPAL AND INDUSTRIAL DISCHARGES

Several communities in the study basin discharge treated sanitary wastewater and water treatment plant backwash water to adjacent streams (Figure 1 and Plate I). The secondary sewage facility in Havre is nearly completed, and Glasgow is in the process of repairing their lagoon and installing facilities to chlorinate the effluent. Both Harlem and Chinook have water treatment plant discharges.

TABLE 4. CHARACTERISTICS OF SIGNIFICANT MUNICIPAL AND INDUSTRIAL DISCHARGES

TSS - Total Suspended Solids
Spec. Cond. - Specific Conductance
DO - Dissolved Oxygen
BOD_5 - Five-day Biochemical Oxygen Demand

Est. - Estimated
(M) - Measured
STP - Sewage Treatment Plant
WTP - Water Treatment Plant

Waste Source and Location(1)	Waste Source Treatment Type	Identification Receiving Water	Discharge Permit No.	Discharge Type	Date Sampled	Discharge Characteristics(2) (units are mg/l unless otherwise shown)
Gildford 32N 11E 03 BAA	None	Sage Creek	MT 0021717	Continuous	1-23-74	pH . . . . . 8.3 Fecal Coliforms 840,000/100 ml TSS . . . . . 10 Spec. Cond. . . 4900 DO . . . . . 0.0 BOD_5 80
Big Sandy 28N 13E 18D	Lagoon	Big Sandy Creek	To be processed	Continuous	7-24-74	BOD_5 . . . . . 170 Fecal Coliforms 39,000/100 ml
Rocky Boy Agency 29N 15E 22B	Lagoon	Box Elder Creek	To be processed	Continuous	2-19-74	Flow . . . . . 30 gpm (M) pH . . . . . 7.4 Fecal Coliforms 2,000,000/100 ml TSS . . . . . 1.5 Spec. Cond. . . 2300 DO . . . . . 3.3 BOD_5 20
Burlington Northern 32N 16E 04 CA	Lagoon	Milk River	MT 0000370	Continuous	5-5-74	Flow . . . . . 1 gpm (M) TSS . . . . . 32 Total Coliforms 25,000/100 ml Phenol . . . . . 20 Spec. Cond. . . 2400
Havre STP 32N 16E 04 CAA	Secondary Treatment(3)	Milk River	MT 0022535	Continuous	4-11-74	Flow . . . . . 835 gpm (M) pH . . . . . 7.2 Fecal Coliforms <1/100 ml TSS . . . . . 65 Spec. Cond. . . 2900 BOD_5 380
Chinook WTP 33N 19E 34 BA	None	Milk River	MT 0023264	Intermit-tent	4-11-74	Flow . . . . . 33 gpm (M) pH . . . . . 7.9 Spec. Cond. . . 800 TSS . . . . . 189 BOD_5 20

Waste Source and Location[1]	Waste Source Treatment Type	Identification Receiving Water	Discharge Permit No.	Discharge Type	Date Sampled	Discharge Characteristics[2] (units are mg/l unless otherwise shown)
Chinook STP 33N 19E 35 BD	Secondary	Milk River	MT 0020125	Continuous	4-11-74	pH . . . . . 8.8 TSS . . . . . <2 BOD_5 . . . . . 60 Fecal Coliforms <1/100 ml Spec. Cond. . . 900
Harlem WTP 32N 23E 30DB	None	Milk River	MT 0000931	Intermit-tent	4-10-74	Flow . . . . . 1400 gpm (M) pH . . . . . 7.10 TSS . . . . . 36 Total Coliforms 18/100 Spec. Cond. . . 550 BOD_5 65
Harlem STP 32N 23E 30DB	Secondary Treatment	Milk River	MT 0021270	Continuous	4-9-74	Flow . . . . . 40 gpm Est. pH . . . . . 7.5 TSS . . . . . 32 Fecal Coliforms <1/100 ml Spec. Cond. . . 1700 BOD_5 150
Malta 30N 29E 07DA	Lagoons	Milk River	MT 0020889	Continuous	4-9-74	Flow . . . . . 20 gpm Est. pH . . . . . 7.4 TSS . . . . . 18 Fecal Coliforms 220,000/100 ml Spec. Cond. . . 1400 BOD_5 120
Saco 31N 34E 17A	Lagoon	Beaver Creek	MT 0020473	Continuous	3-12-74	Flow . . . . . 10 gpm Est. pH . . . . . 7.4 TSS . . . . . 54 Fecal Coliforms 35,000/100 ml Spec. Cond. . . 1500 BOD_5 130
Hinsdale 31N 36E 33CA	Secondary	Milk River	MT 0021881	Continuous	5-15-74	Fecal Coliforms . 60,000/100 ml BOD_5 120
Glasgow 28N 39 E 13 DD	Lagoon - being up-graded	Milk River	MT 0021211	Continuous	4-9-74	Flow . . . . . 300 gpm Est. pH . . . . . 7.4 TSS . . . . . 18 Fecal Coliforms 32,100 per 100 ml Spec. Cond. . . 2000 BOD_5 180
Sunburst 36N 02W 17B	None	Dry Lake	MT 0021679	Continuous	5-13-74	Fecal Coliforms . 5,800,000/100 ml BOD_5 215

Waste Source and Location[1]	Waste Source Treatment Type	Identification Receiving Water	Discharge Permit No.	Discharge Type	Date Sampled	Dicharge Characteristics[2] (units are mg/l unless otherwise shown)
Sweetgrass 37N 03W 02 AA	Lagoon	To a coulee		Intermit-tent	3-7-74	Flow . . . . . 20 gpm Est. BOD_5 . . . . . 107 Fecal Coliforms 55,000/100 ml

(1) See Appendix C.
(2) From data collected by the Water Quality Bureau during the Milk River basin study.
(3) Not completely working.

Gildford

Gildford, a community of 320 persons, presently utilizes private septic tanks for sewage disposal. As the soil will not accept the septic effluent, there is a piping network to collect the septic tank overflow and discharge it into Sage Creek at two different locations near the city. Gildford is relatively high on the proposed 1975 fiscal year priority list and should receive funding for sewage treatment facilities. The estimated untreated load of this system has a population equivalent* of 200. The population equivalent of treated sewage is unknown, but the estimated flow is 1,500 gallons per day.

Big Sandy

Big Sandy, a community of 1,042 persons, utilizes eight, ten and twelve-inch collection pipe in the sewage system. A lift station on the north edge of town transmits the sewage through a six-inch forcemain to a nine-acre, single cell stabilization pond, which eventually discharges to Big Sandy Creek. The estimated load of this lagoon has a population equivalent of 800. The population equivalent of the lagoon effluent is 100, and there is a flow to Big Sandy Creek of 60 gallons per minute.

Rocky Boy Agency

The Rocky Boy Agency sewage system serves an estimated 200 persons. The treatment facility is a two-cell, two-acre stabilization pond located approximately 1,000 feet from the northeast corner of the community. The average flow to Box Elder Creek is 30 gallons per minute. Estimated load of untreated sewage has a population equivalent of 100, and the treated effluent has a population equivalent near zero.

Burlington Northern Engine Shop, Havre

Presently, the Burlington Northern engine shop has a discharge to a two-cell lagoon. The first cell has a surface area of approximately 1,030 square feet and contains an oil trap. Oil skimmed off the surface of the

---

*See Appendix A.

first cell is stored in an oil tank and then eventually is sent to a refinery. Water from the first cell is pumped to the second cell, which has a surface area of about 12,650 square feet. In the second cell, a small amount of oil-water separation occurs, additional evaporation occurs, and an effluent of approximately 25 gallons per minute is discharged to the Milk River. Burlington Northern has funding to install a chemical treatment system but is presently investigating methods to determine the system best suited for the situation.

Havre Sewage Treatment Plant

Havre, a community of approximately 10,500 persons, is presently served by a sewer system consisting of approximately 140,000 lineal feet of eight-inch or larger pipe and approximately 1,400 lineal feet of six-inch pipe. This system includes two lift stations and has in the past discharged to a primary treatment facility located on the northeast edge of the city adjacent to the Milk River. Construction is nearing completion on an improved treatment facility. This plant is being constructed on the site of the existing facility and will utilize much of that facility. The new plant will include the following: grit removal facility, comminution equipment, two 50,000 cubic feet aeration basins, two final clarification basins with total capacity of 320,000 gallons, and chlorination facilities. Effluent is then discharged to the Milk River. Sludge from this process is handled through two 260,000 gallon aerobic digesters and then pumped to a storage lagoon having 440,000 cubic feet capacity and located approximately one mile north of Havre. The facility is designed for an average flow of 1.8 million gallons per day with an 85 to 90 percent treatment efficiency anticipated.

Chinook Water Treatment Plant

Water for the Chinook water treatment plant is derived from the Milk River where pumps deliver 300,000 gallons per day to the plant. Chemicals used are alum, Separan, and carbon in the mixing basin, and chlorine ahead of the settling basin. Backwashing facilities, usually done once per day, require approximately 10,000 gallons of water, which is then discharged to the Milk River. The backwash discharged to the river contains the entire treatment plant wastes, including the treatment plant chemical residual waste and water to clean the filters.

Chinook Sewage Treatment Plant

By means of eight, ten and twelve-inch collection pipes, the Chinook sewer system serves 2,230 persons. A 15-inch outfall line carries the sewage to the southeast corner of Chinook to a mechanical treatment facility consisting of a comminutor, bypass screens, raw sewage pumps, a 35-foot diameter clarigester, a 53-foot diameter rotary trickling filter, a 30-foot diameter final clarifier, gas chlorination and sludge drying beds. As an odor problem occurred in drying the sludge in proximity to the city and as septic tank pump trucks needed a sludge disposal facility, sludges from both the city sewage treatment plant and from septic tanks are buried in pits near the city landfill. Estimated untreated load to this facility has a population equivalent of 300, and there is an estimated effluent discharge to the Milk River of 0.15 million gallons per day.

Harlem Water Treatment Plant

Water for Harlem is derived from the Milk River at a point located southeast of town. Water from the reservoir is pumped into two large raw water storage reservoirs having a total capacity of 18 million gallons. Initial treatment at the plant consists of coagulation and a 350-gallon per minute accelerator water treatment unit. Backwashing of the filters depends on the water demand from the town but usually is done once per day. Each backwash requires approximately 10,000 gallons of water, which is discharged to the Milk River. Backwash discharged to the river contains the entire treatment plant wastes, including the treatment plant chemicals, residual waste, and water to clean the filters. Recirculating this backwash to the storage reservoirs to eliminate the discharge to the river is a recent topic of discussion.

Harlem Sewage Treatment Plant

The Harlem sewage system serving 1,275 persons consists of an eight-inch collection system, a ten-inch outfall line, and a mechanical sewage treatment facility, which is located south of Harlem. This facility consists of a comminutor, bypass bar screen, primary clarifier, aerator and disinfection facilities. Sludge, after being dried, is disposed of on available land.

Dodson

The 300 residents of Dodson utilize an eight-inch sewage collection system. A lift station on the southwest edge of the community forces the sewage through a six-inch

pipe to the treatment facility--a three-acre single cell stabilization pond. The estimated load to this facility has a population equivalent of 180. There is an intermittent effluent flow with an estimated population equivalent of 20 to a nearby ditch.

Malta

By means of eight-inch, ten-inch, and twelve-inch collection pipes, the Malta sewage system serves 2,535 persons. At the north edge of town, a 16-inch outfall carries the sewage to a lift station on the south bank of the Milk River. From the lift station, the sewage is pumped through a ten-inch forcemain across the Milk River to the treatment facility, which is an 18.8 acre, two-cell stabilization pond. The estimated load to this pond has a population equivalent of 2,200. There is an estimated effluent flow to the Milk River of 0.1 million gallons per day with a population equivalent of 400.

Saco

The 475 residents of Saco utilize a sewage system having a collection pipe of unknown size. A lift station on the southeast edge of town forces the sewage through an eight-inch pipe to the treatment facility, which is a five-acre, two-cell stabilization pond located southeast of town. The estimated load to this facility has a population equivalent of 350. There is an estimated effluent flow to Beaver Creek of 10 gallons per minute with a population equivalent of near 50.

Hinsdale

The community of Hinsdale, a community of 320 persons, utilizes a sewage system having a collection pipe believed to be eight inches. The treatment facility, located between Fourth Avenue and Fifth Avenue on Ohio Street, consists of a comminutor, an aerator tank, a clarifier tank, and chlorination equipment to provide secondary treatment before the effluent is discharged to the Milk River. When sludge removal is required from this system, a semi-liquid sludge is pumped to mobile tanks and is then spread on pasture land.

Glasgow

Glasgow, a community of 4,700 persons, currently utilizes a sanitary sewer system, and in some cases, a combined sewer

system which varies in size from eight inches to 42-inch pipe to collect and transport wastewater to a lift station adjacent to the Milk River. The sewage is then pumped by two 1,000 gallon per minute pumps through a 14-inch forcemain to a two-cell, 40-acre waste stabilization lagoon constructed in 1959. This facility is currently being modified to increase capacity and improve treatment efficiency. When completed, the treatment facility will consist of two aeration cells, each approximately 2.5 acres in size, followed by a settling pond. The wastewater is then disinfected and flows through a chlorination dissipation pond prior to discharge to the Milk River. The new facility will be designed for a maximum flow of 0.7 million gallons per day and a population equivalent of 7,000. It is estimated that the new facility will provide a minimum of 90 percent BOD removal and with this system, sludge disposal will be only an infrequent item with adjacent lands being utilized as the disposal site.

Sunburst

The Sunburst sewage collection system, consisting of six, eight and ten-inch lines, serves approximately 875 persons. There are two septic tanks in the system--one of unknown capacity, the other a 40,000 gallon septic tank located 700 feet east of Sunburst. The septic tanks overflow to a dry lake bed. From the septic tanks, there is an estimated flow of 0.03 million gallons per day with a population equivalent of 600. There are federal assistance funds appropriated to finance 75 percent of the planning costs for a sewage treatment facility.

Sweetgrass

The Sweetgrass sewage system, consisting of an eight-inch collection pipe and an eight-inch outfall line, serves approximately 225 persons. The sewage treatment facility consists of a 3.2-acre wastewater stabilization pond located approximately 1,200 feet east of Sweetgrass. The estimated sewage load to the lagoon has a population equivalent of 150. There is only an intermittent effluent discharge of which the population equivalent is considered near zero.

AGRICULTURAL DISCHARGES

A variety of agricultural wastes are present in the Milk River basin, including irrigation return flows, animal wastes, runoff from range and cultivated lands, and from land treated with pesticides and fertilizers. There are numerous potential water quality problems due to these

agricultural practices, but only three specific water quality problems have been identified. Soil Conservation Service environmental engineers are presently designing facilities for the Doll hog farm to eliminate a groundwater contamination problem, and the Vita Rich Dairy and the Eldon Seamons Dairy have compliance schedules to eliminate runoff and discharges to state waters. Agricultural pollution is transient in both time and space and is complex due to the variability of agricultural practices. The effect of agricultural wastes on water quality generally is difficult to determine without long-term studies. Other than the problems mentioned above, gross agricultural pollution problems in the basin are not apparent. However, the summation effect of the many small agricultural abuses is felt to be significant. Future water quality monitoring and additional basin investigations will assist in quantification of agriculture's role in water quality. Several agricultural waste discharge permit applications for the basin have been received. Characteristics of the Doll hog farm water pollution problems are listed in Table 5.

Strommen Hereford Ranch

The Strommen Hereford Ranch currently maintains two animal confinement facilities. Facility No. 1 is located in the SW 1/4, SE 1/4, Section 32, Township 32 North, Range 34 East in Phillips County approximately two miles north of Saco, Montana. This facility encompasses 2.5 acres and has capacity for approximately 400 cattle. Facility No. 2 is located in the SE 1/4, SW 1/4, Section 32, Township 32 North, Range 34 East in Phillips County and is approximately one-half mile west of Facility No. 1. This facility encompasses 1.8 acres and has capacity for approximately 200 cattle. The surface runoff from each animal confinement facility is contained by a retention structure which has been designed to store in excess of the runoff which can be expected from a 10-year, 24-hour rainfall event. The waste material which accumulates in the retention structure will be disposed of through evaporation or by pumping onto adjacent agricultural land (Permit No. F-2-B issued April 9, 1973).

Charles Schwenke Feedlot

Mr. Charles Schwenke currently operates an animal confinement facility located in the W 1/2, SW 1/4, Section 9, Township 32 North, Range 22 East in Blaine County approximately five miles west of Harlem, Montana. The

TABLE 5. CHARACTERISTICS OF THE DOLL HOG FARM DISCHARGE

Waste Source and Location(1)	Discharge Type	Receiving Water	Permit No.	Date Sampled	Discharge Characteristics(2)
Doll Hog Farm, Havre, Montana (32N 17E 05BB)	Continuous flow feedlot	Groundwater, possibly the Milk River	Pending	5/20/74	Ca . . . . . 72 Mg . . . . . 37 Na . . . . . 232 K . . . . . 60 HCO_3 . . . . . 387 Cl . . . . . 98 SO_4 . . . . . 444 NO_3 . . . . . 8.5 PO_4 . . . . . 21 TSS 50

(1) See Appendix C.

(2) From data collected by the Water Quality Bureau during the Milk River basin study.

facility encompasses approximately 20 acres and has a capacity for 4,000 head of beef cattle. Surface runoff from the feeding area is contained in a retention pond having a storage volume of approximately 15 acre-feet. The waste material which accumulates on the feedlot surface and in the retention pond is then disposed of on approximately 385 acres of surrounding agricultural land (Permit No. F-10-B issued June 11, 1974).

Krall Farms

Mr. J. W. Krall has operated since 1963 a total confinement swine operation having an annual maximum capacity of approximately 1,000 animals. The animal confinement facility is located in the SW 1/4, NW 1/4, Section 1, Township 36 North, Range 1 West in Toole County approximately ten miles east of Sunburst, Montana. Livestock, with the exception of brood sows, are held within a confinement building, and the waste materials which are produced drop through the slatted floors into a liquid manure pit beneath the building. In addition, an earthen lagoon has been constructed for emergency overflows. Waste materials are periodically removed from the liquid manure pit and spread on approximately 1,400 acres of agricultural land (Permit No. MT 0029006 issued June 18, 1974).

Heavirland Farms

Mr. Loren Heavirland currently operates an animal confinement facility located in the SE 1/4, SW 1/4, Section 9, Township 36 North, Range 2 West in Toole County approximately one and one-half miles northeast of Sunburst, Montana. This animal confinement facility encompasses approximately ten acres and has a capacity for 1,200 head of swine. Surface runoff from the open lot facility is contained in three separate retention ponds, each designed to store in excess of the 10-year, 24-hour rainfall event from the contributing drainage area. The waste material which accumulates in the retention pond will be periodically removed and disposed of on approximately 900 acres of agricultural land (Permit No. F-15-H issued July 19, 1973).

Hinsdale Livestock Company

The Hinsdale Livestock Company operates an animal confinement facility located in the NW 1/4, SE 1/4 and the SW 1/4 of the NE 1/4 of Section 33, Township 32 North, Range 35 East in Valley County approximately nine miles northwest of Hinsdale, Montana. This facility encompasses approximately 15 acres and has a capacity for approximately 2,000 beef steers and heifers. Contaminated surface runoff from the

area is contained in two natural retention structures created by the topography of the area. These areas provide sufficient capacity to store the runoff which could be expected from a 10-year, 24-hour rainfall event. Waste material which accumulates in the retention pond will be disposed of through evaporation or disposal onto approximately 1,200 acres of agricultural land (Permit No. MT 0022519 issued November 30, 1974).

Holman Hereford Home, Inc.

The Holman Hereford Home, Inc. operates an animal confinement facility located in the NE 1/4 of the SW 1/4 of Section 12, Township 30 North, Range 27 East of Phillips County approximately three and one-half miles east of Dodson, Montana. This facility encompasses approximately 25 acres and has a capacity for approximately 900 beef breeding animals. At the present time, surface runoff and waste material from this animal confinement facility could, on occasion, discharge to the Milk River. The waste discharge permit application is currently under review, and a compliance schedule will be established to bring this discharge in line with current effluent limitations.

Vita Rich Dairy, Inc.

Vita Rich Dairy, Inc. currently maintains a dairy operation located in Sections 3 and 4, Township 32 North, Range 17 East in Hill County approximately eight miles east of Havre, Montana. The animal confinement facility encompasses approximately 30 acres, and the dairy herd numbers approximately 220 cows. Waste materials from a portion of the open lot area currently are discharged to the Milk River. The waste discharge permit application is presently under review, and a compliance schedule will be established to eliminate this discharge in accordance with the present effluent limitations.

Seamons Dairy

Mr. Eldon Seamons currently maintains a confined dairy operation located in the SW 1/4, SW 1/4, Section 25, Township 33 North, Range 19 East in Blaine County approximately two miles southeast of Chinook, Montana. The animal confinement facility encompasses approximately six acres and has a capacity for approximately 150 dairy cows. At the present time, surface runoff from a portion of the open lot area as well as wastewater from the milk parlor is discharged directly to West Fork Creek (Lodge Creek). An application

for waste discharge permit for this operation is currently under review, and a compliance schedule will be established to eliminate this discharge in accordance with current effluent limitations.

Art Hauge, Turner

This family-operated hog farm south of Turner (Section 12, Township 35 North, Range 25 East) has a capacity of 1,000 hogs. Located on relatively level sandy loam, the operation is a complete production operation in that hogs are bred, farrowed, fattened, and marketed. Both the farrowing house and the nursery building have liquid manure pits which are pumped semi-annually. Manure is then dispensed over adjacent fields.

Treasure State Testing Station

Treasure State Testing Station has a 500-bull or 800-feeder cow capacity and is presently a weight-gain monitoring operation located in Section 4, Township 32 North, Range 16 East. Beef animals placed in this feeding operation in the fall of the year are fed a specific ration, and their weight gain is continually monitored. Waste material is removed each spring and disposed of on agricultural land. As there is no direct discharge to surface water and as surface runoff is contained within the area, this operation is not a water pollution problem.

Northern Montana Agricultural Research Center

Northern Montana Agricultural Research Center, having a capacity of 100 cattle, is located approximately six miles southwest of Havre, Montana (Section 28, Township 32 North, Range 15 East). Cattle are generally confined only during the fall and winter months within this facility. Wastes are annually removed from the facility and are disposed of on adjacent agricultural land. Wastewater or surface runoff is prevented from reaching Beaver Creek by a diversion dike and an irrigation ditch.

MINING ACTIVITY

The small amount of mining activity of the Milk River is of two types--coal and bentonite. The last coal mine to operate in this basin was the Milk River coal mine northwest of Chinook. This mine was abandoned by the owner in 1972 because of strict federal regulations that made the mine seem economically unfeasible. Other abandoned coal mine sites are scattered in the area north of Chinook, north of Havre, and in the Sweetgrass Hills north of Chester.

Bentonite mining has not been fully developed, but there has been some mining southeast of Glasgow and other sites have been explored south of Malta. Mining, in general, has not been a water pollution problem in the Milk River basin.

NON-POINT SOURCES

Some potential non-point pollution sources have been discussed under agricultural wastes and fertilizers. All can create non-point pollution sources. A variety of other non-point pollution sources exist, including erosion and deposition of sediment from construction projects, agricultural and logging areas, toxic substances, and salinity from saline soils in the area. Identifying non-point sources of pollution is difficult and would require considerable effort. Several irrigation return flows and some saline seep waters were collected and analyzed as part of this investigation.

There are numerous naturally alkali or saline soils due to poor drainage. Saline seep areas, for purposes of this report, are considered to be those recently developed saline soils that are related to cropping practices. Such soils restrict or completely stop agricultural productivity. Saline seeps are not only detrimental to crops but cause losses to wildlife populations, livestock, aquatic life, and may be creating long-term problems in streams and underground water supplies. The mechanism creating saline seeps is due to infiltration of precipitation into salt-laden soils, solution of salts into groundwater, and the subsequent reappearance of these salts at the ground surface. The crop-fallow system greatly aggravates this problem (Bahls and Miller, 1973). Characteristic saline seep waters tend to be high in conductivity, bicarbonates, sodium, sulfates, total dissolved solids, and metals (Table 6).

The Soil Conservation Service is presently mapping saline seep areas and is presently conducting a variety of experiments and studies to determine the severity of the problem and best land use methods to control saline seep. Detailed information on the intial studies is not yet available. The Water Quality Bureau is also doing water analyses and assembling information to determine the severity of the problem and investigating the quality of water involved.

TABLE 6. NON-POINT SOURCE WATER ANALYSES RESULTS

Sample Description and Location (1)	Ca	Mg	Na	Fe	Mn	Cl	Pb	Cu	Zn	HCO_3	CO_3	SO_4	Cl	N	F	Cd	Spec.Con. 25° C	TDS	pH	Se	Mo	Cr	V	As
Bob Turner Ranch, flows from gulleys, banks and low hills (37N 06E 22BCC)		6375	6375	.81	.41	250	<.01	.06	.11	2123	0	9573	250				>10,000	24,696	8.1	.09	.1	<.01	<.01	
Herb Karst Seep Flow from Banks, Gulleys and Low Hills (37N 01E 19CBA)	1300	9500	8539			1550				817	348	52,906	1550	1019			>10,000	73,160	8.6					
Sage Creek at Highway 2 Below Gildford (T32N R11E 03BAA)	120	78	1010	1.5		245	.01	<.01	.04	1123		1413			.87	.01	4968.0	10	8.3					

(1) See Appendix C

Irrigation return flows also have been indicated as non-point agriculturally related discharge problems. In the Milk River basin, the weed-choked, silt-filled, slow-flowing irrigation return flows are significant because of the increasing saline seep problem, the quality of water returned to the Milk River, and they may contribute to health problems of the area. Table 7 indicates by county a four-year saline seep increase.*

TABLE 7. ACRES OF SALINE SEEP ON CROPLAND

County	1969	1971	1973	% Increase
Glacier	2,000	3,000	3,000	50
Liberty	200	220	4,300	2,150
Toole	1,500	1,800	2,000	33 1/3
Valley	250	800	3,000	833
Phillips	300	360	400	33 1/3

Table 8 indicates the general quality of water from irrigation return flow samples collected during this study. Other samples will be collected and analyzed to satisfy initial self-monitoring irrigation return flow permit requirements.

Table 9 indicates the waste discharge permit applications for irrigation activities in the Milk River basin.

*Soil Conservation Service data.

TABLE 8. IRRIGATION RETURN FLOW WATER QUALITY

Return Flow and Location(1)	Ca	Mg	Na	HCO_3	CO_3	SO_4	Cl	Spec.Cond. 25° C	pH	DO	PO_4
Dave Leo 32N 22E 26AA	38	18	53	246		73	6	552	8.7	2.5	0.84
Harlem Irrigation Return on Love Farm Lane 32N 23E 24DA	32	14.7	47	235		51	1.5	462.6	7.82	2.5	0.31
Irrigation Return 1.9 miles south of Zurich 32N 21E 06DDA	96	33	100	543	6	97	15	1021.0	8.40		

(1) See Appendix C

TABLE 9. WASTE DISCHARGE PERMIT APPLICATION FOR IRRIGATION ACTIVITIES

APPLICANT NAME	LOCATION	PERMIT NO.	NUMBER OF IRRIGATED ACRES	ESTIMATED RETURN FLOW IN ACRE-FEET PER YEAR
Alfalfa Valley Irrigation District	Chinook	MT 0022942	3,800	3,800
Fort Belknap Irrigation District	Chinook	MT 0023213	6,482	
Glasgow Irrigation District	Malta	MT 0023272	18,011	31,240
Harlem Irrigation District	Harlem	MT 0023086	11,148	8,000
Malta Irrigation District	Malta	MT 0023281	43,500	60,000
Paradise Valley Irrigation District	Chinook	MT 0023396	8,315	8,900
Zurich Irrigation District	Chinook	MT 0023132	7,664	8,000

The above waste discharge permit applications are currently on file with the department. These discharges will be evaluated during the next irrigation season and permits may be issued.

Finally, the irrigation systems in their present weed-choked conditions contribute to mosquito breeding and the associated mosquito transmitted diseases. Mosquitoes found in Montana transmit the virus which causes Western equine and St. Louis encephalitis in man and horses. Table 10 indicates the encephalitis (sleeping sickness) activity during 1971 and 1972.

Mosquito problems and their causes can have many direct and indirect effects on economy and recreation in rural areas. The problem is especially serious in older irrigation systems, such as along the Milk River, where overall drainage plans need to be developed and adequate return flow systems need to be provided. The conditions that contribute to mosquito production contribute to less than optimum hay production (both in quality and in quantity), and contribute to more saline problems. Research performed at Louisiana State University and published in the J. Econ. Ent. deomonstrated that mosquito populations can cause a highly significant ($P<0.01$) reduction in average daily weight gain in cattle.

Because irrigation return flows in the Milk River basin are associated with many economic and health problems, it is felt they should be the priority non-point project in this basin (Table 11).

Studies published in 1956 reveal that in northern Montana, 75 percent of the families surveyed reported some mosquito annoyance and that there was injurious reaction in 80 percent of the interviewed individuals. About 40 percent of the individuals examined by a physician showed evidence of secondary infection to mosquito bites. Some individuals, especially children, frequently required medical treatment, and sometimes hospitalization, for secondary infections and allergic reactions. Nearly one-half of the Chinook families surveyed reported that mosquitoes prevent children from playing outdoors for two to four months in the summer. Recreational opportunities and opportunities for relaxation are affected, and in turn affect man's mental and physical well-being.

From the distribution of cases, it has been confirmed that the area of Montana having the highest incidence of encephalitis occurs along the highline and in the eastern portion of the state but that it also occurs (less frequently) in the western portion. Blaine County had the highest encephalitis infection rate with 8.9 percent, and Phillips County had 7.6 percent.

TABLE 10. WESTERN EQUINE ENCEPHALITIS DURING 1971 AND 1972

County	1971 Total Cases Man	1972 Horses
Glacier		1
Toole	1	
Hill	3	
Blaine	1	4
Phillips		6
Valley	activity in chickens	1

TABLE 11. NON-POINT SOURCE PROBLEM RANKING AND BENEFITS FROM CONTINUED WORK ON THE PROBLEM

Problem	Benefits
1. Irrigation return flow	A. Improved water quality B. Control saline seep Increased crop production C. Mosquito control benefits Decreased mosquito transmitted diseases Decreased costs of mosquito control Economic benefits
2. Saline seep	A. Improved water quality B. Increased crop production
3. Agricultural runoff (feedlots)	A. Improved water quality
4. Water turbidity from natural erosion in Milk River and Big Sandy Creek	A. Improved water quality
5. Coliform counts in the Milk River from Canada to Fresno Reservoir	A. Decreased coliforms

VII. SURFACE WATER RESOURCES

The Milk River basin contains ten major sub-basins (Figure 1 and Plate I):

1. Milk River from its origin in the mountains of Glacier Park to the western international crossing into Canada and from the eastern international crossing as the Milk River again enters the United States to Fresno Dam (40F).

2. Sage Creek from its origin on the eastern slopes of the Sweetgrass Hills to its mouth into Big Sandy Creek (40G).

3. Big Sandy Creek from its origin in the Bearpaw Mountains to its mouth into the Milk River (40H).

4. Peoples Creek from its origin in the Little Rocky Mountains to its mouth (40I).

5. Lodge Creek (West Fork Creek), Battle Creek (North Fork Creek), Beaver Creek (near Havre), and Clear Creek (40J).

6. Whitewater Creek (40K)

7. Frenchman Creek from where it enters the United States from Canada to its mouth (40L).

8. Beaver Creek (near Saco) from its origin in the Little Rocky Mountains to its mouth (40M).

9. Rock Creek, Willow Creek and Bitter Creek (40N).

10. The eastern portion of the Milk River basin, several intermittent streams and Porcupine Creek (40O).

The Milk River and its major tributaries in the basin are shown schematically in Figure 3. The U. S. Geological Survey has had 31 stream flow gaging stations in the Milk River basin of which 16 remain active (Figure 1 and Plate I). U. S. Geological Survey data for gaging stations in the study basin are summarized in Table 12. In addition, there are 32 international stream gaging stations located in Canada outside the study area.

Stream flows in the Milk River basin are affected by local weather conditions, geology, reservoirs and irrigation (Table 13). A major part of flow occurs during spring runoff. March through early July is the most common snow melt period, but warm weather in mid-winter can produce significant short-term increases in stream flows. Peak flows from mountain streams, such as the south fork of the Milk River, tend to occur from mid-May through early July; whereas, foothill streams and lowland streams, such as Lodge Creek and Battle Creek, have peak flows in April. The Milk River at Havre is controlled by Fresno Dam and fluctuates in response to downstream water users' demand for municipal supplies and for irrigation. The Milk River stream flow at Harlem varies according to water released by both the Pleasant Valley irrigation diversion dam and the Fort Belknap irrigation diversion dam.

Stream flow of Beaver Creek, below Beaver Creek Park, can be regulated by an SCS reservoir located at the northern end of the park. This was a multi-purpose project constructed for water recreation, irrigation, and watershed control.

The stream flow of Lodge Creek may be altered by the Middle Creek Reservoir located in Canada (T01 R30W Sec. 21A). Water from this reservoir is used for irrigation and to maintain levels of Orleans Lake, but it may be released to Lodge Creek via Ducks Unlimited outlet, Simms Lake, and Walburger Coulee.

The stream flow of Frenchman Creek may be altered by any of several reservoirs in Canada. These reservoirs, Cypress Lake, Eastend Reservoir, Val Marie West Reservoir, and Val Marie Reservoir were built for irrigation purposes and have a combined storage capacity of 112,900 acre feet.

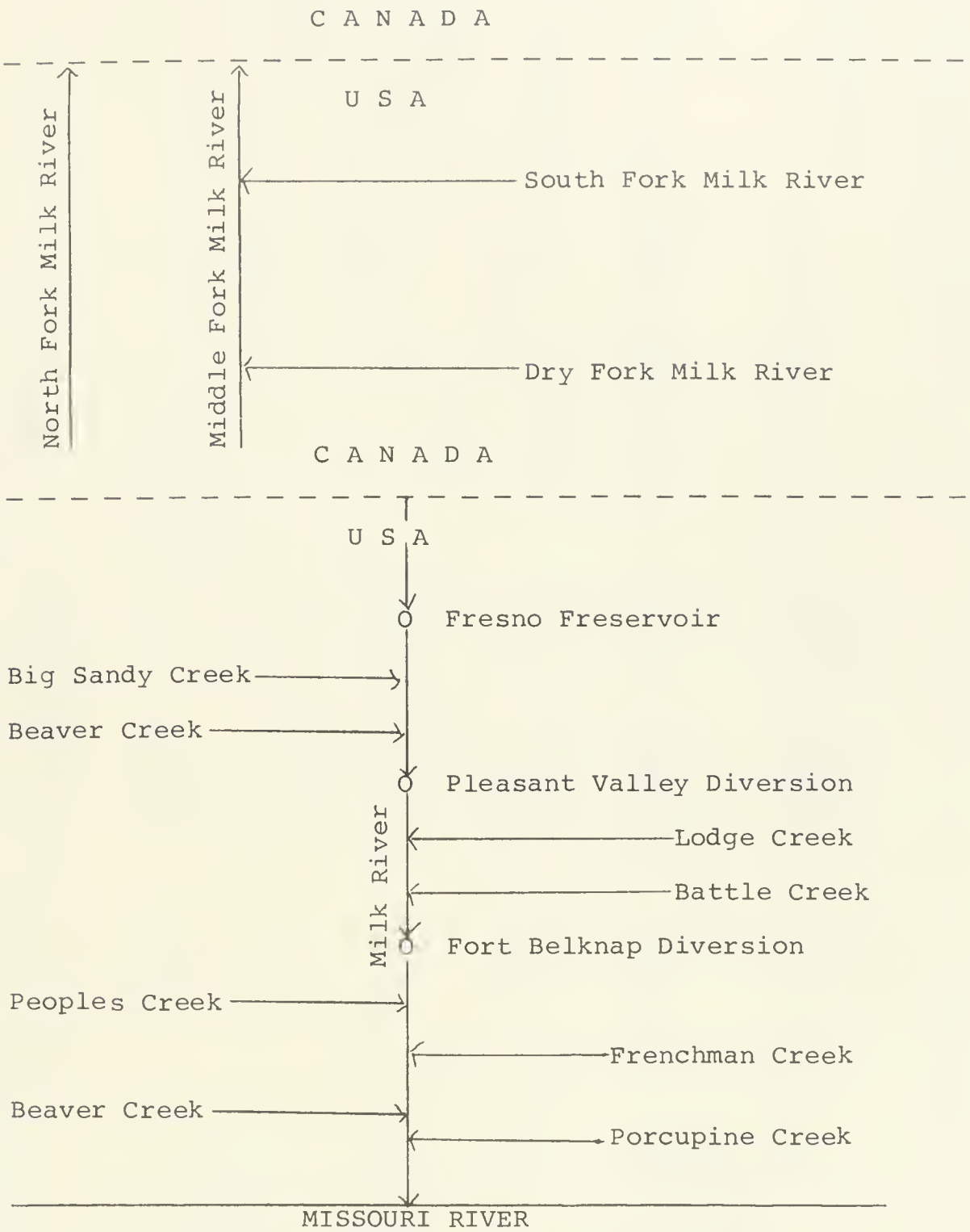


FIGURE 3. SCHEMATIC DIAGRAM OF STREAMS IN THE MILK RIVER BASIN

TABLE 12. SUMMARY OF U. S. GEOLOGICAL SURVEY STREAMFLOW GAGING STATION DATA
(Partial Record Stations Not Included)

Station Name and USGS No.	Location[1]	Minimum Stream Flow (cfs) Instantaneous	Minimum Stream Flow (cfs) Daily	7-Day, 10-Year Low Flow (cfs)	Average Annual Flow (cfs)	Period of Record
So. Fork Milk Rv. near Babb, MT 06132200	35N12W34BBA	11	6.0	not determined	not determined	1961 Seasonal
No. Fork Milk Rv. above St. Mary Canal near Browning, MT 06133500	37N11W16ABA	0	not determined	not determined	not determined	May 1911, July 1912, June - July 1918, May 1919
Milk Rv. at eastern crossing international boundary 06135000	37N10E07BA	0	0.2	not determined	not determined	1909
Milk River at Havre, MT 06140500	32N16E05DDA	0	38	not determined	not determined	May - Nov. 1898, April 1899 - Nov. 1922, March, April 1923, March, April 1952, June 1953, August 1954
Battle Creek at international boundary 06149500	01 26W04D[2]	0	not determined	not determined	not determined	1917

(1) See Appendix C.
(2) This is a Canadian description.

Station Name and USGS No.	Location[1]	Minimum Stream Flow (cfs) Instantaneous	Daily	7-Day, 10-Year Low Flow (cfs)	Average Annual Flow (cfs)	Period of Record
Woodpile Coulee near international boundary 06150000	37N17E08B	0	not determined	not determined	not determined	1927
East Fork Battle Creek near international boundary 06150500	37N20E17B	0	not determined	not determined	not determined	1927
Peoples Creek near Hays, MT 06154400	29N23E35C	0	not determined	not determined	16.9	1966
Peoples Creek near Dodson, MT 06154500	30N26E21BD	0	not determined	not determined	33.5	April 1918-November 1921, June 1951
Frenchman River at international boundary 06164000	01 10W05D[2]	0	not determined	not determined	not determined	1917
Whitewater Creek near international boundary 06156000	37N29E24B	0	not determined	not determined	not determined	1927
Rock Creek below Horse Creek near international bundary 06169500	37N37E15BA	0	not determined	not determined	not determined	March 1916-October 1926, 1956-
McEachern Creek at international boundary 06170000	37N36E01C	0	not determined	not determined	not determined	1924-

(1) See Appendix C.
(2) This is a Canadian description.

Station Name and USGS No.	Location[1]	Minimum Stream Flow(cfs) Instantaneous	Daily	7-Day, 10-Year Low Flow (cfs)	Average Annual Flow (cfs)	Period of Record
Willow Creek near Hinsdale, MT 06170200	32N36E01A	0	not determined	not determined	24.4	1965
Milk River at Vandalia 0617200	30N37E15BD	0	7.4	not determined	728	October 1914, September 1925, August 1928, September 1939, October 1969
Willow Creek near Glasgow, MT 06714000	27N39E10ABC	0	not determined	not determined	56.3	1953
Milk River at Nashua, MT 06174500	27N41E01AA	0.6	not determined	not determined	699	1939
Milk River near Harlem, MT 6-1541	32N23E32ACC	not determined	9.4	not determined	410	October 1959, September 1969
Beaver Creek above Dix Creek 6-1648	32N23E32ACC	0	not determined	not determined	not determined	October 1966, September 1969
North Chinook Canal near Havre, MT 6-1640	35N17E02D	0	not determined	not determined	not determined	April 1921-Sept. 1924, May 1928-October 1951, March 1952, Oct. 1967
Frenchman Canal near Saco, MT 6-1645	33N34E26B	0	not determined	not determined	not determined	October 1920-Sept. 1921, October 1927-October 1950, April 1951-October 1967

(1) See Appendix C.

Station Name and USGS No.	Location[1]	Minimum Stream Flow (cfs) Instantaneous	Daily	7-Day, 10-Year Low Flow (cfs)	Average Annual Flow (cfs)	Period of Record
Lime Creek near Tampico, MT 6-1722	30N38E15B	0	not determined	not determined	5.38	October 1957-Sept. 1967
Milk River near Del Bonita, MT 6-1327	37N09W23AB	0	14	not determined	97.6	October 1930-May 1905, April 1962-November 1964

(1) See Appendix C.

TABLE 13. TYPICAL STREAM FLOW DATA FOR MILK RIVER BASIN (USGS Water Resources Data 1972)
Monthly Mean Discharges (cfs) for Water Year 1971 - 1972

Station	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Total For Year Acre Feet	Total For Average Year Acre Feet
So. Fork nr. Babb, MT	24.0	--	--	--	--	136	112	193	185	76.5	40.1	25.0	March - Oct.---- 48,020	
Milk Rv. at eastern crossing international boundary	229	--	--	--	--	1183	504	921	859	793	759	740	----	----
Milk Rv. at Havre, MT	164	60.0	50.1	45.6	49.6	185	318	867	1026	990	758	599	156,442	310,800
Battle Cr. at international boundary	9.44	--	--	--	--	61.4	26.5	22.8	82.3	12.4	14.8	0.77	March - Oct.---- 13,950	
Peoples Cr. near Dodson, MT	0.048	2.84	0.13	0	0.43	73.0	22.8	11.4	86.7	3.77	0.037	0	Water Year 6,119.77	24,270
Frenchman Cr. at international boundary	2.70	--	--	--	--	87.0	144	27.5	41.0	24.7	8.28	0.18	March - Oct.---- 20,260	
Milk River at Vandalia, MT	123	165	119	101	106	1334	234	274	1639	261	260	232	293,200	527,400

Station	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Total For Year Acre Feet	Total For Average Year Acre Feet
Milk River at Nashua	115	185	117	113	104	1803	361	519	2263	387	615	301	416,600	506,400

VIII. WATER QUALITY

Other than water samples analyzed for this report, water quality has been measured in only eight USGS stations in the Milk River basin, Montana (Table 14). Water quality data for streams discussed in this report appear in Table 15. Water quality ranges from excellent in mountainous streams to very turbid in lowland streams. The Milk River basin has been divided into four segments for purposes of this discussion.

The first segment includes the North Fork of the Milk River, the Milk River Dry Fork, and Milk River South Fork, and the portion of the Milk River before crossing the international boundary into Canada. The second segment includes the Milk River from the eastern crossing of the Milk River into the United States to Havre. The third segment includes the Milk River and its tributaries from Havre to Cottonwood Creek northwest of Malta. Segment four includes the Milk River and its tributaries from Cottonwood Creek to the mouth of the Milk River into the Missouri River below Fort Peck Dam.

TABLE 14. MILK RIVER USGS WATER QUALITY STATIONS

Station Name Agency & No.	Location[1]	Period of Record	Sampling Intervals	Water Quality Parameters
Milk River at Havre, MT 06149500 USGS	32N16E05DDA	Aug. 1964-Sept. 1972	Daily Composite	Dissolved: SiO_2, Fe, Ca, Mg, Na, K, Cl, F, P, Solids, HCO_3, CO_3, SO_4, pH, Specific Conductance, Sodium Adsorption Ratio, Temperature
Battle Creek at international boundary 06149500 USGS	0126204D[2]	April-Sept. 1972	Semi-monthly	Dissolved: SiO_2, Fe, Ca, Mg, Na, K, N, P, Cl, F, Solids, As, Cd, Cr, CO, Pb, Mn, Hg, Zn, Temperature, HCO_3, CO_3, BOD, Aldrin, Lindane, Chlordane, DDD, DDE, DDT, Dieldrin, Endrin, Hepatchlor, Hepat-chlorepoxide, 2,4-D, 2,4,5-T, Silvex, Specific Conductance, DO, pH, Coliform, $CaCO_3$
Frenchman Rv. at international boundary 06149500 USGS	0110W05D[2]	April-Sept. 1972	Semi-monthly	Temperature, Aldrin, Lindane, Chlordane, DDD, DDE, DDT, Dieldrin, Endrin, Hepta-chlor, Heptachlorepoxide, 2,4-D, 2,4,5-T, Silvex
Milk River at Vandalia, MT 06172000 USGS	30N37E15BD	Oct. 1969-Sept. 1972	Monthly	Dissolved: SiO_2, Fe, Ca, Mg, Na, K, SO_4, Cl, F, N, P, HCO_3, CO_3, Sodium Adsorption Ratio, Specific Conductance, pH, Temperature, Solids, B, Mn
Milk River near Glasgow, MT 06174200 USGS	28N40E29BA	Oct. 1971-Sept. 1972	Monthly	Dissolved: Ca, Mg, Na, SO_4, Cl, F, Solids, As, Be, Cd, Cr, Cu, Cn, N, P, Pb, Mn, Hg, Mo, Ni, Se, Ag, Zn, Aldrin, Lindane, Chlordane, DDD, DDE, DDT, Dieldrin, Endrin, Hepta-chlor, Heptachlorepoxide, 2,4-D, 2,4,5-T, Silvex, Temperature, Specific Conductance, DO, pH, Coliform

(1) See Appendix C.
(2) This location is a Canadian designation.

Station Name Agency & No.	Location[1]	Period of Record	Sampling Intervals	Water Quality Parameters
Milk River near Harlem, MT. 6-1541 USGS	32N23E32ADD	Oct. 1968-Sept. 1969[2]	Monthly	Dissolved: Solids, Fe, SiO_2, Ca, Mg, Na, K, HCO_3, CO_3, SO_4, Cl, F, Specific Conductance, NO_3, Br, Sodium Adsorption Ratio, Specific Conductance, pH, Color
Milk River at Nashua, MT 6-1745 USGS	27N41E01CC	Oct. 1964-Sept. 1965[2]	Monthly	Dissolved: Solids, SiO_2, Fe, Ca, Mg, Na, K, HCO_3, CO_3, SO_4, Cl, F, NO_3, B, Sodium Adsorption Ratio, Specific Conductance, pH, Color
Willow Creek near Glasgow, MT 6-1740 USGS	27N39E10AC	Oct. 1963-Sept. 1964	Monthly	SiO_2, Fe, Ca, Mg, Na, K, HCO_3, CO_3, SO_4, Cl, F, NO_3, B, Solids, Sodium Adsorption Ratio, Specific Conductance, pH, Color

(1) See Appendix C.
(2) Interrupted Period of Record.

TABLE 15. MILK RIVER WATER QUALITY SUMMARY(1)

Temperature - °C
Specific Conductance - µmhos/cm at 25° C
pH - Standard Units
Dissolved Calcium - Ca
Dissolved Magnesium - Mg
Dissolved Sodium - Na
Dissolved Potassium - K
Bicarbonate - HCO_3

Carbonate - CO_3
Sulfate - SO_4
Chloride - Cl
Fluoride - Fl
Nitrate - NO_3
Ortho Phosphate - PO_4

FC - Fecal Coliforms per 100 ml

(3)TR Manganese - Mn
TR Cadmium - Cd
TR Zinc - Zn
TR Arsenic - As
TR Iron - FE
TR Copper - Cu
TR Lead - Pb
DO - Dissolved Oxygen

Station and Location(2)	Date Sampled	Temp.	pH	Ca	Mg	Na	K	HCO_3	SO_4	Cl	NO_3	Fl	PO_4	FC	Spec. Cond.	Mn	Cd	Zn	As	Fe	Cu	DO
Milk River No. Fork 37N 11W 16AC	4-1-74	1.0	7.8	28	23	7.1	2.5	212	9.5	1.2	.45	.13	.04	70	340	.06	<.001	<.01	.01	.27	<.01	10.8
Milk River at Hwy. 483 37N 09W 23AB	4-1-74	2.0	7.7	41	41	6.0	10	161	11.3	0.2	.60	.11	.10	110	280	.05	<.001	.01	<.01	.49	<.01	11.5
Milk River below Fresno Dam 33N 14E 20C	1-11-74	2.0	8.1	42	18.2	62		229	122	6.0	1.2		.07	<1	628	.04	<.01	<.01	<.01	.17	<.01	11.2
Milk River at Hwy. 2 West of Malta 30N 30E 18BD	3-13-74	.5	7.5	34	9	62	5.7	127	128	12.2	.91	.12	.29	<1	490	.31	<.001	.03	<.01	4.2	.01	10.4
Milk River at Hwy. 2 Br. East of Hinsdale 31N 36E 33CA	3-28-74	.5	7.6	16.2	5.7	27	6.5	66	63	2.2	.86	.12	.11	470	260	.52	<.001	.08	<.01	16	.01	10.4
Milk River at Mouth 27N 42E 32AA	3-25-74	1.0	7.6	42	15	49		143	139	5.0	1.51	.5	.20	412	540	.08	<.01	.08	<.01	2.67	<.01	11.3

(1) Concentrations are in milligrams per liter unless otherwise indicated.
(2) See Appendix C.
(3) TR - Total Recoverable (5 ml concentrated nitric acid added to 1,000 ml of unfiltered sample).

Station and Location	Date Sampled	Temp.	pH	Ca	Mg	Na	K	HCO_3	SO_4	Cl	NO_3	Fl	PO_4	FC	Spec. Cond.	Mn	Cd	Zn	As	Fe	Cu	DO
Big Sandy Creek at Hwy. 2 Br. 32N 15E 05DC	2-11-74	1.0	7.9	42	26	100		349	128	11.6	1.2		.37	58	800	.05	<.01	.01	<.01	1.1	<.01	10.8
Beaver Creek Bridge N. Side BN RR 30N 15E 22DB	4-11-74	6.0	8.5	64	35	88		365	162	8.5	0	.25	.11	<1	930	.04	<.01	<.01	<.01	.10	<.01	10.4
Lodge Cr. Hwy. 2 Bridge E. of Chinook 33N 19E 26BD	2-27-74	1.0	7.7	83	34	103		356	260	6.5	.38		1.1	118	1000	.24	<.01	<.01	<.01	.98	.01	4.5
Battle Creek Bridge E. of Chinook 33N 20E 27CD	2-27-74		7.8	81	44	150		334	393	27	.5		.12	140	1280	.40	<.01	<.01	<.01	.81	.01	9.7
Peoples Creek at Hwy. 2 Crossing 31N 26E 32CC	3-7-74	0.5	8.1	63	33	80		268	223	6.0	.05	.39	.04	4	900	.02		.01	.01	.27	<.01	8.9
Frenchman River Br. N. of Saco 32N 34E 13CC	3-14-74	0.5	7.2	38	24	86		122	268	5.8	.75		1.1	28	750	.36	<.01	.04	<.01	7.2	<.01	10.9
Beaver Creek Co. Rd. W. of Hinsdale 31N 36E 30CC	3-14-74	0.2	7.1	34	14.2	63		96	180	10	.40		.67	6	550	.16	<.01	.03	<.01	6.4	<.01	9.1
Porcupine Creek at Mouth 27N 42E 08BB	3-25-74	0.5	7.9	34	14.0	85		199	151	5.0	.96	.4	.24	20	650	.08	<.01	.04	<.01	1.27	<.01	11.7

MILK RIVER, NORTH FORK

The Milk River, North Fork, begins on the eastern slopes of the Rocky Mountains in Glacier National Park. It flows northeastward down the slopes and onto the hilly terrain of the Blackfoot Indian Reservation, eventually crossing the international boundary into Canada where it joins other branches of the Milk River. As it begins in Glacier National Park, upper portions of this stream are undisturbed by mining, agriculture, or logging. Flows of the Milk River, North Fork, increase in response to mountain snow melts in April, May, and June. Flows also are significantly increased in June, July, and August by water diverted for irrigation from the St. Mary's River through the St. Mary's River canal. Water of the Milk River in this area is of excellent quality, a calcium-bicarbonate, hard water and contains small amounts of other constituents (Table 15).

MILK RIVER, ORIGIN AND FLOW INTO CANADA

Several streams, mainly the Middle Fork, Dry Fork of the Milk River, Livermore Creek, Toad Creek, and South Fork of the Milk River make up a southern branch of the Milk River before it enters Canada. Most of the streams originate on the eastern slopes and foothills of the Rocky Mountains in Glacier National Park and merge at various places to form this southern branch of the Milk River. The general course of this segment of the river is northeastward, parallel to the North Fork of the Milk River until it enters Canada. Upper portions of these streams are undisturbed by activities such as mining, logging, and agriculture; but as the stream flows across the hilly terrain of the Blackfoot Indian Reservation, several large ranches pasture livestock along the stream banks. The significance of pasturing livestock along streams under this type of pasture condition is that fecal coliform counts are increased, especially during spring runoff. Peak flows of this stream occur during May and June snow melts, and flows are affected during June, July, and August by several irrigation diversion dams. This water is a calcium-bicarbonate, hard water, and contains small amounts of other constituents (Table 15).

MILK RIVER FROM CANADA TO HAVRE

After flowing through Canada for approximately 150 river miles, the Milk River again enters the United States approximately 30 miles northwest of Gildford, Montana. Its flow is then southeastward to Fresno Reservoir and then to Havre.

Considerable farming occurs along the Milk River in Canada, but most agricultural activity involves pasturing, and as such, is not a major water pollution problem. The Milk River flows are regulated by Fresno Dam with peak flows occurring in May, June, and July, corresponding to the irrigation demands from water users downstream. Limited samples collected during this study indicate the coliform concentration exceeds state standards, but these samples were collected during runoff when coliform counts are naturally high. A more detailed study is needed to confirm the high coliform counts.

Big Sandy Creek

Big Sandy Creek and Beaver Creek flow into the Milk River just above Havre. Big Sandy Creek, a nonregulated tributary, affects the Milk River greatest during spring runoff. The water quality of Big Sandy Creek deteriorates because of stream bank erosion and irrigation practices. Near the mouth, Big Sandy Creek is a calcium-bicarbonate type of hard water and contains small amounts of other constituents (Table 15). A more detailed study is required to determine the complete impact of stream bank erosion on the creek. The study should include a differentiation between natural erosion and man-caused erosion, silt loading of the stream, and effects of silt on the aquatic biota.

Beaver Creek

Beaver Creek has a new SCS control dam (as of 1974) and will probably not greatly influence the flow or quality of the Milk River. Beaver Creek and Big Sandy Creek originate in the Bearpaw Mountains south of Havre and in the mountainous areas, have waters of excellent quality. With the new SCS dam on Beaver Creek, the water quality of Beaver Creek is anticipated to remain of a good quality to its mouth into the Milk River (Table 15).

MILK RIVER FROM HAVRE TO COTTONWOOD CREEK

The Milk River in the past has been the disposal system of the highline area with municipalities, industries, agriculture, and private citizens disposing of wastes into the river. It flows generally in an easterly direction from Havre to Chinook, Harlem, Dodson, and Malta. Havre, Chinook, Harlem, and Malta all have sewage disposal system effluents of various qualities going into the Milk River. There is extensive irrigation along this portion of the river, and the water quality is degraded by stream bank erosion, irrigation runoff,

and by occasional dead animals in the river. One industry (in the process of updating) discharges a waste high in oils and greases. Finally, private citizens occasionally dispose of scrap lumber, abandoned cars, and outdated machinery into the Milk River. The flows of the Milk River in this segment are affected by irrigation, weather, and the tributaries of Lodge Creek, Battle Creek, and Peoples Creek. In the lower portion of this segment, the Milk River is a calcium-bicarbonate type, hard water, and contains small amounts of other constituents (Table 15). This segment of the river was initially classified by the state as water quality limited, but limited samples indicate this segment of the river to meet state standards. A more detailed study is needed to determine if these waters meet state standards.

Lodge Creek and Battle Creek

Both Lodge Creek and Battle Creek originate in the relatively hilly terrain of Canada, and their flow and water quality are affected by Canadian agricultural grazing and irrigation practices. In Canada, both streams have storage reservoirs. Water quality is similar, and in general, is of good quality. Water of both streams is a calcium-bibarbonate type, hard water, and contains small amounts of other constituents (Table 15). The low dissolved oxygen for Lodge Creek may be attributed to the slow flow and large amounts of aquatic vegetation at this particular sample site.

Peoples Creek

Peoples Creek, the third major tributary of this segment of the Milk River, has minor branches originating in both the Bearpaw Mountains and the Little Rocky Mountains. Its flow is generally in a northeastward direction to its confluence with the Milk River. Most of Peoples Creek is on the Fort Belknap Indian Reservation and is relatively undisturbed by mining, agricultural, and logging practices. Most of the stream passes through grazing land, but the extreme lower portion is used to flood irrigate wild hay. In 1972, the peak flow occurred in March and had a monthly mean of 73 cubic feet per second. The water quality of Peoples Creek is generally good. It is a calcium-bicarbonate type, hard water, and contains small amounts of other constituents (Table 15). It has been reported in the past that during an exceptionally high runoff, leacheates from mine tailings had increased arsenic concentrations to levels killing fish.

MILK RIVER FROM COTTONWOOD CREEK TO ITS MOUTH AT THE MISSOURI RIVER

From Cottonwood Creek northwest of Malta, the Milk River flows generally eastward past Malta, Saco, Hinsdale, Glasgow, and Nashua to its confluence with the Missouri River. This segment of river is entirely in agricultural lands, and agricultural practices influence both the flow and quality of the river. Agricultural practices, such as grazing livestock along the stream banks, increase coliform counts, especially during periods of runoff; and other agricultural practices such as irrigation diversion and irrigation returns change the flows and probably the quality of the Milk River. A more detailed study is needed to confirm the complete impact of irrigation diversions and of irrigation returns. The water of this stream segment is a calcium-bicarbonate type, hard water, and contains small amounts of other constituents (Table 15). Three tributaries, Frenchman River, Beaver Creek, and Porcupine Creek, supplement the Milk River in this final segment.

Frenchman River

Flows of Frenchman River originating in Canada are controlled by a series of Canadian reservoirs, including Cypress Lake, Eastend Reservoir, Val Marie West Reservoir, and Val Marie Reservoir. Water of this river in the United States is a calcium-bicarbonate type, hard water, and contains small amounts of other constituents (Table 15). Water quality of this stream is fair, as indicated by propagation of several fish species and a diversified aquatic eco-system.

Beaver Creek

Beaver Creek originates on the eastern slopes of the Little Rocky Mountains and flows generally northeastward to its mouth into the Milk River. Its course is primarily through agricultural land, but the Saco stabilization lagoon also discharges to this creek. Flow data has not been collected on Beaver Creek, but it is speculated that the snow melts of the Little Rocky Mountains and the irrigation practices would be the most significant influencing factors in these readings. Beaver Creek near its mouth is a calcium-bicarbonate type, hard water, and contains small amounts of other constituents (Table 15). Water quality of this stream is of fair quality as indicated by aquatic biota productivity.

Porcupine Creek

Porcupine Creek, the third tributary of this segment of the Milk River, begins in the hilly lands north of Glasgow. It flows southward through agricultural lands, mostly dryland farms, to its mouth into the Milk River. Flow data has not been collected on Porcupine Creek, but it is speculated that the spring snow melts of this hilly terrain would be the most significant factor affecting the flow. Water of this stream is a calcium-bicarbonate type, hard water, and contains small amounts of other constituents (Table 15). Water quality of this stream is of a fair quality as indicated by propagation of limited fish species and of its support of the aquatic biota.

Table 16 summarizes the problems of different streams and indicates where further work is needed to maintain or improve water quality.

TABLE 16. STREAMS AND CONDITIONS REQUIRING FURTHER STUDY

Stream	LOCATION * Beginning	End	Comments
Milk River from Canada to Fresno Reservoir	37N 09E 04	35N 12E 10	Samples taken during the study indicate high turbidity and high coliform. Samples were collected during runoff but confirmation data should be collected.
Milk River	32N 16E 04	33N 19E 33	Was classified as water quality limited. Samples collected and analyzed do not support this classification. Confirmation data should be collected.
Big Sandy Creek	30N 13E 33	32N 15E 04	Samples collected indicate high turbidity. Work should be done to determine causes.
Lodge Creek	37N 15E 12	33N 19E 26	Samples collected indicate a low dissolved oxygen for the entire stream. Confirmation data should be obtained and possibly eutrophication studies made.
Milk River Below Hinsdale	31N 36E 33	27N 42E 32	Samples collected indicate this stream segment to be high in turbidity and fecal coliform. Samples were collected during runoff when these values are naturally high. There have since been treatment facility improvements. Confirmation data should be collected.

*See Appendix C

IX. WASTE DISCHARGE PERMITS

The Montana state program of issuing waste discharge permits is operated under authority of the Montana water pollution control law. Statutory authority to apply and enforce state compliance schedules in state permits are Section 69-4806(3), 69-4808.2 (1)(f)(1) and (2), 69-4820, 69-4820.1, and 69-4823, Revised Codes of Montana, 1947. The applicable rule is existing MAC 16-2.14(10)-S14460, Montana Pollutant Discharge Elimination System (MPDES), Section (2)(b)(ii), effective March 8, 1974. Twelve municipal, one industrial, seven agricultural, and two water treatment plant waste discharge MPDES permits have been issued (December 31, 1974) by the state of Montana; and the Environmental Protection Agency has issued an NPDES permit to the federally-operated water treatment plant in this basin. Seven agricultural permittees have no discharge to state waters, but permits are pending for three agricultural operations that do discharge to state waters. MPDES permits are listed in Table 17. The Milk River basin feedlot permits are listed in Table 18.

The Environmental Protection Agency has issued a waste discharge permit to the federal installation at Glasgow Air Force facilities. There is a potential for 28 other permits to be issued to dischargers in the basin. Dischargers not assigned a permit number had not made application as of August 31, 1974. Three additional permits for agricultural discharges are anticipated. All municipalities on compliance schedules are expected to meet secondary treatment requirements by July 1, 1977. Facility descriptions and effluent characteristics are discussed in section VI.

TABLE 17. MPDES PERMITS IN THE MILK RIVER BASIN
(Current as of August 31, 1974)

Facility and Location(1)	MPDES Permit No.	Date Issued	Expiration Date	Compliance Schedule
Alfalfa Valley Irri. *exact location unknown*	MT 0022942	To be issued		
Big Sandy, Town 28N 13E 18D	MT 0021377	"		
Chinook WTP 33N 19E 35BD	MT 0023264	"		
Chinook, Town 33N 19E 34BA	MT 0020125	"		
Dodson, Town 30N 37E 05BB	MT 0021415	"		
Ft. Belknap Irr. *exact location unknown*	MT 0023213	"		
Gildford 32N 11E 03BAA	MT 0021717	"		
Glasgow Irr. *exact location unknown*	MT 0023272	"		
Glasgow, City 28N 39E 13D	MT 0021211	3-22-74	12-31-76	1-1-75(2)
Harlem Irr. Dist. 32N 23E 24DA	MT 0023086	To be issued		
Harlem, City 32N 23E 30DB	MT 0000931	4-30-74	12-31-76	Immediately
Harlem, City 32N 23E 30DB	MT 0021270	To be issued		
Havre, City 32N 16E 04CAA	MT 0022535	1-11-74	12-31-76	2-15-75(2)
Hingham, Town 33N 11E 03DD	MT 0021300	To be issued		

(1) See Appendix C
(2) Discharge must meet secondary effluent requirements by date specified.

Facility and Location(1)	MPDES Permit No.	Date Issued	Expiration Date	Compliance Schedule
Malta Irrigation *exact location unknown*	MT 0023281	To be issued		
Malta, City 30N 29E 07DA	MT 0020889	"		
Nashua, Town 27N 42E BD	MT 0022144	"		
Paradise Valley Irr. *exact location unknown*	MT 0023396	"		
Saco, Town 31N 34E 17A	MT 0020473	"		
Sunburst, Town 36N 02W 17C	MT 0021679	"		
USAF, Glasgow AFB (MPDES) 30N 40E 04AC	MT 0000965	2-26-74	12-31-76	Submittal re-required 5-26-74
USBIA, Ft. Belknap Irrigation *exact location unknown*	MT 0023221	To be issued		
USBIA, Rocky Boy Indian Agency 29N 15E 22B	MT 0020761	"		
Valley County Commissioners 31N 36E 31DA	MT 0020656	"		
Valley County SID 2 29N 39E 33CC	MT 0021610	"		
Zurich Irrigation *exact location unknown*	MT 0023132	"		

(1) Appendix C

TABLE 18. MILK RIVER BASIN FEEDLOT PERMITS ISSUED

Facility and Location(1)	Permit Number	Date Issued	Description of Facility
Strommen Hereford Ranch, Saco 32N 34E 22DC	F-A-B	4-9-74	Lot #1 - 400 head beef operation Lot #2 - 200 head beef operation
Charles Schwenke, Harlem 32N 22E 09C	F-10-B	6-11-73	Expanding existing beef operation to 4,000 head capacity
Loren Heavirland, Sunburst 36N 02W 09BD	F-15-H	7-19-73	Proposed 1,200 head swine operation
Art Hauge, Turner 35N 25E 12BC	MT 0029003	5-24-74	Existing 1,000 head confined swine operation
Treasure State Testing Station, Havre 32N 16E 04DA	MT 0029005	6-18-74	Existing 800 head beef testing station
Krall Farms, Sunburst 36N 01W 01BC	MT 0029006	6-18-74	Existing 400 head confined swine operation
Northern Montana Agricultural Research Center, Havre 32N 15E 28CD	MT 0029010	7-3-74	Existing 100 head confined beef operation
Hinsdale Livestock Co, Hinsdale 32N 35E 33AC	MT 0022519	11-30-74	Existing beef operation
Adrian Doll, Havre	P E N D I N G		Existing swine operation
Vita Rich Dairy	P E N D I N G		Existing dairy
Eldon Seamons Dairy	P E N D I N G		Existing dairy

(1) See Appendix C.

Federal permits were issued pursuant to the National Pollutant Discharge Elimination System (NPDES) created by the Federal Water Pollution Control Act Amendments of 1972 (FWPCAA of 1972). To eliminate the duplication of effort which formerly existed, Montana was given the authority to administer the NPDES program in Montana on June 10, 1974. Section 402 of the FWPCAA of 1972 provides that states with adequate water pollution control programs may apply for and receive authority from the EPA to issue permits under the NPDES in their own states. Montana made the necessary revisions to the state water pollution control laws during the 1973 legislative session to provide statutory authority for administration of the NPDES program in Montana. In addition, the Board of Health and Environmental Sciences adopted a rule entitled the Montana Pollutant Discharge Elimination System (MPDES). The MPDES rule provides the additional program elements needed by the state to comply with rules and regulations promulgated by the administrator of EPA pursuant to Section 304(h) of the FWPCAA of 1972. Section 304(h) relates to the state program elements necessary to administer the NPDES program.

X. WASTE LOAD ALLOCATIONS

The Milk River from its eastern crossing of the international boundary (T37N, R9E, 03) to the upper end of Fresno Reservoir (T36N R12E 29) a distance of 32 river miles seems to be of a poor quality because of high turbidity and high coliforms. This problem is felt to be, in part, a result of Canadian agricultural and municipal influences rather than a totally naturally occurring phenomenon. Limited samples collected during this study indicate turbidity and high coliform problems; however, these samples were collected during runoff, and both turbidity and coliform counts would naturally be high. A more detailed study is needed to determine that these waters do not meet state standards before this segment is reclassified.

Below Fresno Reservoir, the Milk River has a low turbidity and few coliform bacteria. As the water flows downstream, it increases in suspended solids by erosion of unprotected, unstable stream banks, and thus, becomes a turbid stream.

In the Montana Water Pollution Control Program Plan (1974), that portion of the Milk River between Havre (T32N R16E 04) and Chinook (T33N R19E 33) was classified as a water quality limited segment because of high turbidity, sediments, coliform organisms, and a possible dissolved oxygen problem. Water samples collected and analyzed for this stream segment do not support it being classified as water quality limited, and turbidity data is not available to distinguish between man-made turbidity levels and naturally occurring turbidity levels. Fecal coliform counts are within the state standards.

A segment of the Milk River that does not meet state standards is that portion of the Milk River extending from the Highway 2 bridge one and one-half miles east of Hinsdale (T31N R36E 33) to the mouth of the Milk River into the Missouri River (T27N R42E 32). This portion of the river is high in coliforms and turbidity, but with new sewage treatment facilities at Hinsdale and sewage treatment facilities under construction at Glasgow, coliform bacteria should be reduced, and this segment of the river is anticipated to meet state water quality standards. A more detailed study is needed to determine naturally occurring Milk River turbidity.

If confirmation data shows the Milk River from Canada to Fresno Reservoir to meet state standards, all portions of

the Milk River and the associated tributaries are expected to meet state standards in the near future, and no waste load allocations have been made for the Milk River basin. Confirmation studies should be done in the future to ascertain that these waters will continue to meet state standards.

XI. MANAGEMENT AND STRATEGY

A water quality management strategy should be designed to maintain and enhance water quality in the basin. The strategy also must consider requirements of all federal and state laws and regulations. The Federal Water Pollution Control Act Amendments of 1972 provide that for all discharges other than publicly owned treatment works, not later than July 1, 1977, effluent limitations are to be achieved which represent application of best practicable control technology currently available. By July 1, 1977, publicly owned treatment works will be required to have secondary treatment or any more stringent limitation, including those necessary to meet water quality standards, treatment standards, or schedule of compliance, established pursuant to any state law or regulations (under authority prescribed by Section 510) or any other federal law or regulations, or be required to implement any applicable water quality standard established pursuant to the act.

The Milk River basin contains 4.24 percent of Montana's population or about 25,700 persons (based on 1970 census). Twelve municipalities, one industry, and three agricultural operations discharge wastes to streams within the basin. Havre's sewage treatment plant is the one major discharge in the Milk River basin, and thirteen other minor discharges exist in this basin. From a basin strategy, management programs or plans can be developed and implemented. After plan development and implementation, water and wastes in the basin must be checked to determine the actual influence of the plan on basin waters. Water quality management is an iterative process; that is, a plan must be followed, the results checked, and the program modified, and the results checked again. In the Milk River basin, the basic strategy will consist of:

1. Inadequate municipal sewage treatment has been ranked according to priority (Section XIII) and will be upgraded to meet secondary treatment standards. This will improve the quality of sewage treatment plant effluents and ensure compliance with Montana water quality standards.

2. Operation and maintenance inspections will be made of at least 50 percent of the municipal sewage treatment facilities, and the other 50 percent will be inspected in the subsequent year. Critical installations will be provided additional inspection where possible. EPA form 7500-5 will be utilized for operation and

maintenance inspections. Facilities needing special assistance on operation and maintenance will be handled on a request basis. Assistance of EPA operation and maintenance personnel will be requested where long-term (two or three weeks) assistance will be required.

3. MPDES and NPDES permits (Section IX) are issued or are pending to all dischargers in the Milk River basin.

4. All major industrial and municipal discharges under MPDES permit will be monitored by the Water Quality Bureau personnel for compliance with applicable effluent limitations and compliance schedules at least once during fiscal year 1975. In addition, approximately 50 percent of the minor discharges under permit will be monitored for compliance during fiscal year 1975. Suspended residue, BOD_5, fecal coliforms, and flow will be monitored in all municipal discharges; residual chlorine will be measured where chlorination is provided. Municipal water treatment plant discharges will be monitored for aluminum, suspended residue, turbidity, flow, pH, and residual chlorine. MPDES permits are pending for several feedlot operations and irrigation districts in the Milk River basin; and as yet, wastewater discharge limitations have not been developed.

5. It is the goal of the Montana Department of Health and Environmental Sciences to ensure best practical control technology and best available control technology effluent limitations are met by all industrial dischargers by July 1, 1977, and July 1, 1983, respectively, as required by the Federal Water Pollution Control Act Amendments of 1972, P.L. 92-500, and as further defined by EPA regulations. It is also the goal of the department to achieve no discharge of pollutants to state waters by July 1, 1985.

6. The Milk River basin plan will be used as the basis for establishing priorities for surveillance, construction grants, and permit issuance.

7. Pollution from non-point sources, particularly sediment but also saline seep and nutrients, is considered to be a principal water pollution problem in Montana and the basin. Major non-point pollution problem areas in the basin (Section VI) which may need additional study are irrigation return flows, saline seep, agricultural runoff, water turbidity from natural erosion, and coliform concentrations in the Milk River.

8. The Water Quality Bureau will participate with other regulatory agencies in controlling land use activities to abate potential and existing pollution problems. Specifically, SJR 0052, a joint resolution of the House and Senate passed by the 1974 legislature, states in part:

NOW, THEREFORE, BE IT RESOLVED BY THE SENATE AND THE HOUSE OF REPRESENTATIVES OF THE STATE OF MONTANA:

That the Department of Natural Resources and Conservation and the Resource Conservation Advisory Council in cooperation with the Montana Association of Conservation Districts, the Department of Health and Environmental Sciences, and other interested parties make a thorough study of the sediment control problem, and existing legislation, and recommend to the 1975 Legislative Session appropriate legislation, including proposed rules and standards implementing such legislation, establishing a statewide program for the control of soil erosion and sediment damage.

9. Oil spill inspection and reporting will be coordinated with the EPA, Department of Fish and Game, and the Oil and Gas Conservation Division of the Department of Natural Resources and Conservation.

10. Plans for subdivisions within the basin will be reviewed to assure water supplies and sewage disposal facilities are provided which comply with the state subdivision law and regulation. The law and regulation are administered by the Water Quality Bureau. The law requires approval of subdivision plats, plans, and specifications by the Department of Health and Environmental Sciences before filing with the county clerk and recorder.

11. Enforcement action will be taken to protect water quality. Under the state water pollution control law, enforcement remedies are contained in Sections 69-4820, 69-4820.1, 69-4821, 69-4824, 69-4824.1, and 69-4825. Penalty provisions are contained in Section 69-4824.

12. Municipalities, industries, and agricultural dischargers will be required to monitor their own discharges. Frequency and parameters will be in accordance with MPDES permit conditions, and results will be submitted to the Water Quality Bureau and EPA. Authority to apply and enforce state compliance schedules in state permits is discussed in Section IX. Authority to enforce stream water quality standards is discussed in Appendix B.

13. Selected water quality monitoring stations will be continued (Table 19) as a long-range water quality surveillance network. This network will be in addition to studies of identified problem areas (Section VI and VIII).

XII. SURVEILLANCE PLAN

A surveillance plan is useful for monitoring existing discharges for compliance with permit conditions, checking instream water quality against Montana's water quality standards, and detecting long-term water quality changes in the basin. Therefore, upon completion of the Milk River Water Quality Inventory and Management Plan, a long-range water quality surveillance network will be maintained (Table 19). The principal monitoring effort in fiscal year 1975 will be to identify water quality problems, including effluent discharges. Major streams and problem areas will be sampled and analyzed for major ions, flow, BOD, coliforms, pH, temperature, toxic metals, nutrients, specific conductance, turbidity, and selected additional constituents. As sampling for water quality management is completed, permanent instream stations will be established to provide information on water quality trends. These will complement the other agency stations already established.

The state will do a limited amount of monitoring during the year to determine compliance or noncompliance with effluent limitations contained in waste discharge permits. The major portion of the compliance monitoring activities will be undertaken during the second half of fiscal year 1975 because of excessive laboratory loads during the first half of the year resulting from the department's water quality management planning efforts. Havre is the only major discharge in the Milk River basin.

The Water Quality Bureau will collect and analyze samples from major industrial and municipal discharges yearly. Approximately 50 percent of the minor municipal discharges will be sampled yearly with the balance sampled in alternate years. Municipalities, industries, and agricultural dischargers will be required to monitor their own discharges with frequency and parameters to be in accordance with the MPDES and results to be submitted to the Water Quality Bureau and EPA.

During fiscal year 1975, an engineer within the bureau will be coordinating enforcement. Field personnel located at Helena will be available for providing on-site inspections and investigations. Assistance of the Department of Fish and Game will be solicited and utilized in some investigations. In addition, the bureau will utilize the department's legal unit where legal action is warranted. EPA

has offered the assistance of their legal personnel, and their assistance will be requested where it appears they can better handle the situation.

Two main priorities are:

1. Establish definite uniform procedures and guidelines to be used by the Water Quality Bureau in carrying out administrative and judicial enforcement action.

2. Take necessary action to insure compliance with permit conditions of all waste discharge permits issued in Montana.

TABLE 19. MILK RIVER WATER QUALITY SURVEILLANCE STATIONS

Station Name and Number	Agency	Location (1)	Sampling Interval	Water Quality Parameters
Milk River, Nashua 01674500	USGS	27N41E01AA	Daily Composite	Alkalinity, HCO_3, CO_2, CO_3, Cl, F, Hardness, Fe, SO_4, Specific Conductance, some pesticides, Mg, Mn, Nitrogen Nitrate, Nitrogen Nitrite, pH, PO_4, K, Dissolved Solids, SiO3
Milk River, Tampico 06172310	USGS	30N38E32CCC	Daily Composite	Alkalinity, HCO3, CO_2, CO_3, Cl, F, Hardness, Fe, SO4, Specific Conductance, Mg, Na, Nitrogen Nitrate, Nitrogen Nitrite, pH, PO_4, K, Dissolved Solids, SIO3
Milk River, 7th Avenue Bridge, Havre	WQB	32N16E03DD	Quarterly	Ca, Mg, Na, SO_4, Cl, HCO_3, CO_3, NO_3, Kjeldahl-N, NH_3, Total P, PO_4, F, Specific Conductance, pH, Turbidity, TSS, Temperature, Flow, Fecal Coliforms, Recoverable As, Fe, Zn, Mn, Cu, Cd, Pb
Milk River, One and one-half miles east of Hinsdale	WQB	31N36E33CA	Quarterly	Ca, Mg, Na, SO_4, Cl, HCO_3, CO_3, NO_3, Kjeldahl-N, NH_3, Total P, PO_4, F, Specific Conductance, pH, Turbidity, TSS, Temperature, Flow, Fecal Coliforms, Recoverable As, Fe, Zn, Mn, Cu, Cd, Pb

(1) See Appendix C.

XIII. MUNICIPAL FACILITIES INVESTMENTS

State water quality standards in the Milk River basin will not be violated by any municipal discharge after the application of secondary treatment. Needs, project costs, and scheduling are summarized in Table 20. Data to evaluate cost effectiveness of treatment needs were not available.

TABLE 20. MUNICIPAL SEWAGE TREATMENT NEEDS IN THE MILK RIVER BASIN (1)

Community	Needs Description	Cost Estimate	Status
Glasgow	Correction of storm sewer system; upgrade existing lagoon system	$750,000 FY 1974 funded	Under construction
Nashua	Facility maintenance	$10,000	"
Big Sandy	Treatment including outfall	$50,000	Not on priority list
Rocky Boy	Treatment facility upgrading	$50,000	
Gildford	Main sewer, laterals, treatment	$150,000	FY 1977
Dodson	Upgrade existing treatment	$31,000	Not on priority list
Malta	New sewers and upgrade facilities	$544,000	(2)
Harlem	Collection system expansion	(2)	(2)
Kremlin	Collection system and treatment facilities	(2)	(2)
Havre	RSID North and new sewers; new interceptor	$470,000 $125,000	Not on priority list depends on local people
Rudyard	None	0	0
Hingham	None	0	0
Box Elder	None	0	0
Turner	None	0	0
Chinook	None	0	0
Saco	None	0	0
Sweetgrass	None	0	0

(1) Communities are ranked according to Montana priority system for E.P.A. grants
(2) Not available

Community	Needs Description	Cost Estimate	Status
Hinsdale	None	0	0
Whitewater	None	(2)	(2)
Zurich	None	(2)	(2)
Ft. Belknap Agency	(2)	(2)	(2)

(1) Communities are ranked according to Montana priority system for E.P.A. grants
(2) Not available

XIV. PLANNING NEEDS

Section 208 of the Federal Water Pollution Control Act Amendments of 1972 provides grants to areas having special water quality problems which extend over local jurisdictional boundaries to develop an overall plan for the area. As part of plan preparation, local governments within the designated area are expected to establish an agency or agencies for implementing the water quality management plans, and the implementing agency or agencies would be the only ones which could receive sewage treatment works construction grants. The Milk River basin does not have areas appropriate for 208 planning.

Definite funding will be necessary before planning for future biological monitoring and semi-annual sediment sampling at long-term stations can be completed.

Additional planning effort is needed for study of non-point pollution (Table 11), which is felt to be a major water pollution problem in Montana and the basin. Major areas in need of planning and control in the basin are irrigation return flow control, saline seep inventory, agricultural runoff control, and erosion of stream bank control.

XV. MILK RIVER BASIN PUBLIC HEARING

On October 17, 1974, a public hearing was held at Chinook, Montana, to solicit and incorporate public comments into the Milk River basin plan. People representing the Association of American University Women, the Montana Fish and Game Department, irrigation districts, the U. S. Bureau of Reclamation, League of Women Voters, Community Action, Bureau of Land Management, the Blaine County Conservation District, and others attended and offered many good comments.

In general, these persons, in their comments, supported the Milk River basin study but thought the study should have been extended for at least a year to obtain stream data for the entire year. Comments were also made that indicated strong enforcement against dischargers is desired. The Montana Fish and Game Department also specifically suggested a more detailed study be done on turbidity because of the possible effects on the aquatic biota and because of on-going and proposed bentonite mining in both Phillips and Valley counties.

In conclusion, the comments made at the public hearing are valid. The Water Quality Bureau realizes shortcomings in this study, but because of limited funds and limited manpower, sample collections were necessarily curtailed.

APPENDIX

APPENDIX A

GLOSSARY

Symbol	Definition
NOAA	National Oceanographic and Atmospheric Administration
SCS	U. S. Department of Agriculture, Soil Conservation Service
BR	U. S. Department of the Interior, Bureau of Reclamation
NPDES	National Pollutant Discharge Elimination System
WQB	Montana Department of Health and Environmental Sciences, Environmental Sciences Division, Water Quality Bureau
mgd	million gallons per day
BOD_5	five-day biochemical oxygen demand
gpd	gallons per day
tpd	tons per day
gpm	gallons per minute
mg/l	milligrams per liter
USGS	U. S. Geological Survey
cfs	cubic feet per second
JTU	Jackson Turbidity Units

Symbol	Definition
μmhos	Micromhos per centimeter
TR	total recoverable
EPA	U. S. Environmental Protection Agency
<	less than
~	approximately
≤	less than or equal to
F & G	Montana Department of Fish and Game
ml	milliliter
MPDES	Montana Pollutant Discharge Elimination System
BPT	best practicable treatment
PE	Population Equivalent - the per capita contribution of organic matter. Average values are approximately 0.20 pounds of suspended solids per day and 0.17 to 0.21 pounds of BOD per day.

APPENDIX B

MONTANA STATE DEPARTMENT OF HEALTH
AND
ENVIRONMENTAL SCIENCES

MAC 16-2.14(10)-S14480 WATER QUALITY STANDARDS

(1) Policy statement. The following standards are adopted to establish maximum allowable changes in water quality and establish limits for pollutants which affect prescribed beneficial uses of state waters. The department adopts as a rule the policy that best practicable treatment and control of waste, activity and flow is to be provided to maintain dissolved oxygen and overall water quality at the highest possible levels, and water temperatures, coliform bacteria concentrations, dissolved chemical substances, toxic materials, radioactivity, turbidities, color, odor and other deleterious substances at the lowest possible levels.

(2) Application of standards. The water quality standards are composed of water-use classifications [section (4)], water-use descriptions and specific water quality criteria [section (5)], and general water quality criteria [section (6)].

(a) General water quality criteria apply to all state waters except where in this rule specific water quality criteria are more applicable to a specific water-use classification.

(b) In order to carry out the objective of the rule, existing discharges to state waters shall be brought into compliance with the standards as soon as practicable, and in no case later than three years from the effective date of the rule.

(3) Definitions. Unless statutory definition or the context otherwise requires in this rule:

"Conduit" means any artificial or natural duct, either open or closed, for conveying liquids or other fluids.

"Dewatered stream" means a perennial or intermittent stream whose water has been removed for one or more beneficial uses.

"EPA" means the U. S. Environmental Protection Agency.

"Intermittent stream" means a stream or portion of a stream that flows only in direct response to precipitation; it receives little or no water from springs and no long-continued supply from melting snow or other sources.

"Naturally occurring" means conditions or material present from runoff or percolation over which man has no control or from developed land where all reasonable land, soil and water conservation practices have been applied. Conditions resulting from dams in existence as of July 1, 1971 are natural.

"Mixing zone" means that volume of state water wherein any pollutant may exceed allowable water quality standards.

"Pesticide" means insecticides, herbicides, rodenticides, fungicides or any substance or mixture of substances intended for preventing, destroying, controlling, repelling, altering life processes, or mitigating any insects, rodents, nematodes, fungi, weeds and other forms of plant or animal life.

"Residue" means oils, floating solids and sludge deposits.

"Sediment" means solid material settled from suspension in a liquid; mineral or organic solid material that is being transported or has been moved from its site of origin by air, water or ice and has come to rest on the earth's surface, either above or below sea level; or inorganic or organic particles originating from weathering, chemical precipitation or biological activity.

"Settleable solids" means inorganic or organic particles that are being transported or have been transported by water from the site or sites of origin and are settled or are capable of being settled from suspension.

"Sewer" means a pipe or conduit that carries wastewater or drainage water.

"State waters" means any body of water, irrigation system or drainage system, either surface or underground. This section shall not apply to irrigation waters where the waters are used up within the irrigation system and said waters are not returned to any other state waters. The term "state waters" as used in this rule does not include underground water.

"Storm sewer" or "storm drain" means a sewer that carries storm water and surface water, street wash and other wash waters, or drainage but excludes sewage and industrial wastes.

"True color" means the color of water from which the turbidity has been removed.

"Turbidity" means a condition in water or wastewater caused by the presence of suspended matter resulting in the scattering and absorption of light rays.

(4) Water-use classifications.

MILK RIVER BASIN

Milk River drainage from source (or from the Glacier National Park Boundary) to the International Boundary	B-D$_1$
Milk River drainage from the International Boundary to the Missouri River except the tributaries listed below	B-D$_3$
Big Sandy Creek drainage above Big Sandy	B-D$_1$
Remainder of Big Sandy Creek drainage	B-D$_3$
Beaver, Box Elder and Clear Creek drainages (all near Havre)	B-D$_1$
People's Creek drainage to and including the South Fork of People's Creek	B-D$_1$

(d) B-D1 classification.

(i) Water-use description. The quality is to be maintained suitable for drinking, culinary and food processing purposes after adequate treatment equal to coagulation, sedimentation, filtration, disinfection and any additional treatment necessary to remove naturally present impurities; bathing, swimming and recreation; growth and propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply.

(ii) Specific water quality criteria.

(aa) The average number of organisms in the fecal coliform group is not to exceed 200 per 100 milliliters, nor are 10 percent of the total samples during any 30-day period to exceed 400 fecal coliforms per 100 milliliters. The average number of organisms in the coliform group is not to exceed 1,000 per 100 milliliters, nor are 20 percent of the samples to exceed 1,000 coliforms per 100 milliliters during any 30-day period.

(ab) Dissolved oxygen concentration is not to be reduced below 7.0 milligrams per liter.

(ac) Induced variation of hydrogen ion concentration (pH) within the range of 6.5 to 8.5 is to be less than 0.5 pH unit. Natural pH outside this range is to be maintained without change. Natural pH above 7.0 is to be maintained above 7.0.

(ad) The maximum allowable increase above naturally occurring turbidity is 5 Jackson Candle Units except as is permitted in the general water quality criteria.

(ae) A 1° F maximum increase above naturally occurring water temperature is allowed within the range of 32° F to 66° F; within the naturally occurring range of 66° F to 66.5° F, no discharge is allowed which will cause the water temperature to exceed 67° F; and where the naturally occurring water temperature is 66.5° F or greater, the maximum allowable increase in water temperature is 0.5° F. A 2° F per hour maximum decrease below naturally occurring water temperature is allowed when the water temperature is above 55° F, and a 2° F maximum decrease below naturally occurring water temperature is allowed within the range of 55° F to 32° F.

This applies to all waters in the state classified B-D1 except for Prickly Pear Creek from McClellan Creek to the Montana Highway No. 433 crossing where a 2° F maximum increase above naturally occurring water temperature is allowed within the range of 32° F to 65° F; within the naturally occurring range of 65° F to 66.5° F, no discharge is allowed which will cause the water temperature to exceed 67° F; and where the naturally occurring water temperature is 66.5° F or greater, the maximum allowable increase in water temperature is 0.5° F.

(af) No increases above naturally occurring concentrations of sediment, settleable solids or residues, which adversely affect the use indicated, are allowed.

(ag) Concentrations of toxic or other deleterious substances, pesticides and organic and inorganic materials including heavy metals, after treatment for domestic use, are not to exceed the recommended limits contained in the 1962 U. S. Public Health Service Drinking Water Standards or subsequent editions; no increase of more than 10 percent of the concentration present in the receiving water is permitted; maximum allowable concentrations are to be less than acute or chronic problem levels as revealed by bioassay or other methods.

(ah) True color is not to be increased more than five units above naturally occurring color.

(f) B-D_3 classification

(i) Water-use description. The quality is to be maintained suitable for drinking, culinary and food processing purposes after adequate treatment equal to coagulation, sedimentation, filtration, disinfection and any additional treatment necessary to remove naturally present impurities; bathing, swimming and recreation; growth and propagation of non-salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply.

(ii) Specific water quality criteria.

(aa) The average number of organisms in the fecal coliform group is not to exceed 200 per 100 milliliters nor are 10 percent of the total samples during any 30-day period to exceed 400 fecal coliforms per 100 milliliters. The average number of organisms in the coliform group is not to exceed 1,000 per 100 milliliters nor are 20 percent of the samples to exceed 1,000 coliforms per 100 milliliters during any 30-day period.

(ab) Dissolved oxygen concentration is not to be reduced below 5.0 milligrams per liter.

(ac) Induced variation of hydrogen ion concentration (pH) within the range of 6.5 to 9.0 is to be less than 0.5 pH unit. Natural pH outside this range is to be maintained without change. Natural pH above 7.0 shall be maintained above 7.0.

(ad) The maximum allowable increase above naturally occurring turbidity is 10 Jackson Candle Units, except as is permitted in the general water quality criteria.

(ae) A 3° F maximum increase above naturally occurring water temperature is allowed within the range of 32° F to 77° F; within the naturally occurring range of 77° F to 79.5° F, no thermal discharge is allowed which will cause the water temperature to exceed 80° F; and where the naturally occurring water temperature is 79.5° F or greater, the maximum allowable increase in water temperature is 0.5° F. A 2° F per hour maximum decrease below naturally occurring water temperature is allowed when the water temperature is above 55° F, and a 2° F maximum decrease below naturally occurring water temperature is allowed within the range of 55° F to 32° F.

This applies to all waters in the state classified B-D3, except from the Billings water supply intake to the water diversion at Intake, a 3° F maximum increase above naturally occurring water temperature is allowed within the range of 32° F to 79° F; within the range of 79° F to 81.5° F, no thermal discharge is allowed which will cause the water temperature to exceed 82° F; and where the naturally occurring water temperature is 81.5° F or greater, the maximum allowable increase in water temperature is 0.5° F.

From the water diversion at Intake to the North Dakota state line, a 3° F maximum increase above naturally occurring water temperature is allowed within the range of 32° F to 82° F; within the range of 82° F to 84.5° F, no thermal discharge is allowed which will cause the water temperature to exceed 85° F; and where the naturally occurring water temperature is 84.5° F or greater, the maximum allowable increase in water temperature is 0.5° F.

(af) No increases above naturally occurring concentrations of sediment, settleable solids or residues, which adversely affect the use indicated, are allowed.

(ag) Concentrations of toxic or other deleterious substances, pesticides and organic and inorganic materials including heavy metals, after treatment for domestic use, are not to exceed the recommended limits contained in the 1962 U. S. Public Health Service Drinking Water Standards or subsequent editions, and no increase of more than 10 percent of the concentration present in the receiving water is permitted; maximum allowable concentrations are to be less than acute or chronic problem levels as revealed by bioassay or other methods.

(ah) True color is not to be increased more than five units above naturally occurring color.

(6) General water quality criteria.

(a) The degree of waste treatment required to restore and maintain the standards is to be determined by the department and is to be based on the following.

(i) The state's policy of nondegradation of existing high water quality as described in Section 49-4808.2, R.C.M. 1947.

(ii) Present and anticipated beneficial uses of the receiving water.

(iii) The quality and nature of flow of the receiving water.

(iv) The quantity and quality of the sewage, industrial waste or other waste to be treated.

(v) The presence or absence of other sources of pollution on the same watershed.

(b) Sewage is to receive a minimum of secondary treatment as defined by EPA in accordance with requirements set forth in the Federal Water Pollution Control Act Amendments of 1972.

(c) Industrial waste is to receive, after maximum practicable in-plant control, a minimum of secondary treatment or equivalent (reduction of suspended solids and organic materials where present in significant quantities, effective disinfection where bacterial organisms of public health concern are present, and control of toxic or other deleterious substances) before discharge into state waters.

(d) For design of disposal systems, stream flow dilution requirements are to be based on minimum consecutive seven-day average flow which may be

expected to occur on the average of once in ten years. When dilution flows are less than the above design flow at a point discharge, the discharge is to be governed by the permit conditions developed for the discharge through the waste discharge permit program.

(e) State surface waters are to be free from substances attributable to municipal, industrial, agricultural practices or other discharges that will:

(i) Settle to form objectionable sludge deposits or emulsions beneath the surface of the water or upon adjoining shorelines.

(ii) Create floating debris, scum, a visible oil film (or be present in concentrations at or in excess of 10 milligrams per liter) or globules of grease or other floating materials.

(iii) Produce odors, colors or other conditions as to create a nuisance or render undesirable tastes to fish flesh or make fish inedible.

(iv) Create concentrations or combinations of materials which are toxic or harmful to human, animal, plant or aquatic life.

(v) Create conditions which produce undesirable aquatic life.

(f) No wastes are to be discharged and no activities conducted such that the wastes or activities, either alone or in combination with other wastes or activities, will violate, or can reasonably be expected to violate, any of the standards; (e.g., in a reach of stream classified B-D_1, the total allowable cumulative increase to naturally occurring turbidity conditions in the reach is 5 Jackson Candle Units).

(g) No wastes are to be discharged and no activities conducted which, either alone or in combination with other wastes or activities, will cause turbidities to exceed those allowed by specific water quality criteria; provided, short-term activities necessary to accommodate essential dredging, channel or bank alterations, stream diversions or other construction where turbidities in excess of the criteria are unavoidable, may be authorized by the department under conditions as it may prescribe.

(h) Methods of sample collection, preservation and analysis used to determine compliance with the standards are to be in accordance with the latest edition of Standard Methods for the Examination of Water and Wastewater published by the American Public Health Association or in accordance with tests or procedures that have been found to be equally or more applicable.

(i) For operations of existing water impoundments that cause conditions harmful to prescribed beneficial uses of state waters, it is to be

demonstrated to the satisfaction of the department that continued operations will be done in the best practicable manner to minimize harmful effects and will not violate state laws or department rules. New water impoundments shall be designed to provide temperature variations in discharging water that maintain or enhance the existing propagating fishery and associated aquatic life. As a guide, the following temperature variations are recommended: Continuously less than 40° F during the months of January and February, and continuously greater than 44° F during the months of June through September.

(j) Ponds for waste treatment purposes are not to be located in drainage ways where the volume of drainage water from a 10-year storm entering the ponds exceeds one-half the volume of the pond; provided that, subject to approval by the department as to design and maintenance, ponds located in drainage ways for the express purpose of containing emergency oil spills are permitted.

(k) Dumping of snow from municipal and/or parking lot snow removal activities into waters of the state is prohibited without a permit from the department.

(l) Existing discharges to state waters will be entitled a mixing zone as determined by the department.

(m) Until such time as minimum stream flows are established for dewatered streams, the minimum treatment requirements for discharges to dewatered receiving streams are to be no less than the minimum treatment requirements prescribed.

(n) Treatment requirements for discharges to intermittent streams are to be no less than the minimum treatment requirements prescribed.

(o) Pollution resulting from storm drainage, storm sewer discharges, and non-point sources, including irrigation practices, road building, construction, logging practices, overgrazing and other practices, are to be eliminated or minimized as ordered by the department.

(p) Application of pesticides in or adjacent to state waters is to be in compliance with the labeled direction, and in accordance with provisions of the Montana Pesticides Act (Title 27, Chapter 2, R.C.M. 1947) and the Federal Environmental Pesticides Control Act (Public Law 92-516). Excess pesticides and pesticide containers are not to be disposed of in a manner or in a location where they are likely to pollute state waters.

(q) The following radiological criteria shall apply to all waters except those classified as A-Closed:

(i) The average dissolved concentrations (including the naturally occurring or background contribution) of iodine 131, radium-226, strontium-89, strontium-90 and tritium are not to exceed the following concentration limits:

Iodine-131	5 pCi/L
Radium-226	1 pCi/L
Strontium-89	100 pCi/L
Strontium-90	10 pCi/L
Tritium	3,000 pCi/L

For all other radionuclides, the average dissolved concentration limits are to be 1/150 of the corresponding maximum permissible concentration in water for continuous occupational exposure as recommended by the National Committee on Radiation Protection (National Bureau of Standards Handbook 69 or subsequent revisions.)

(ii) For a mixture of radionuclides, the following relationship is to be satisfied:

$$\frac{C_1}{L_1} + \frac{C_2}{L_2} \ldots + \frac{C_n}{L_n} \leq 1.00$$

C denotes the average concentration of the respective radionuclide, and L denotes its concentration limit.

(iii) Where alpha emitters, strontium-90, radium-228, iodine-129, iodine-130 and lead-210 are known to be absent, routine analyses for dissolved gross beta radioactivity (excluding potassium-40 contribution) may be employed to monitor and show compliance with this criterion (except for tritium) as long as the gross concentration does not exceed 100 pCi/L. When these conditions are not met, routine quantitative analyses of individual radionuclides are to be performed to show compliance. Except in cases where tritium from other than natural sources is known to be absent, routine tritium analyses are to be performed to show compliance. (Note: "Absence" means a negligibly small fraction of the specific concentration limit, where the limit for unidentified alpha emitters is taken as the limit for radium-226.)

(iv) For radionuclides associated with suspended material in transport, the average concentration limits are to be 1/150 of the corresponding maximum permissible concentration in water (insoluble form) for continuous occupational exposure as recommended by the National Committee on Radiation Protection. In-stream sedimentation of these materials is not to produce solids beds that are not in compliance with subsections (q) (i) and (q) (ii) (because of leaching) and/or excessive accumulation in native flora and fauna.

(v) Average concentrations are to be computed from monitoring data acquired during the previous 12 months; maximum concentrations are not to exceed three times the average concentration limits specified.

(vi) Variances from concentration limits specified will be permitted only if the contributing source is non-controllable or a natural source. Best available treatment must be provided for man-made discharges, and the exposure received by affected population groups must be within established dose limits.

(r) No wastes are to be discharged and no activities conducted which, either alone or in combination with other wastes or activities, will result in the dissolved gas content relative to the water surface to exceed 110 percent of saturation.

(s) Bioassay median tolerance concentrations are to be based on latest available research results for the materials, by bioassay tests procedures for simulating actual stream conditions as set forth in the latest edition of Standard Methods for the Examination of Water and Wastewater published by the American Public Health Association, or in accordance with tests or analytical procedures that have been found to be equal or more applicable by EPA. Bioassay studies are to be made using the most sensitive local species and life stages of economic or ecological importance; provided other species whose relative sensitivity is known may be used when there is difficulty in providing the most sensitive species in sufficient numbers.

When specific application factors are not available, the factor is to be determined by using methods listed in Water Quality Criteria published by the Federal Water Pollution Control Administration (1968), or by using other methods accepted as equal or applicable by EPA.

(t) Metal limits for the Clark Fork River (mainstem) from the confluence of Warm Springs Creek to the confluence with Cottonwood Creek are:

Material	Average Daily Concentration ug/l	Maximum Instantaneous Concentration ug/l
Total copper	90	180
Dissolved copper	30	40
Total zinc	300	1,000
Dissolved zinc	80	140
Total iron	1,300	2,200
Dissolved iron	150	160
Total lead	100	100
Dissolved lead	100	100
Total cadmium	10	10
Total arsenic	10	16
Total mercury	1	1

Metal limits for Clark Fork River (mainstem) from the confluence of Cottonwood Creek to the Idaho state line are:

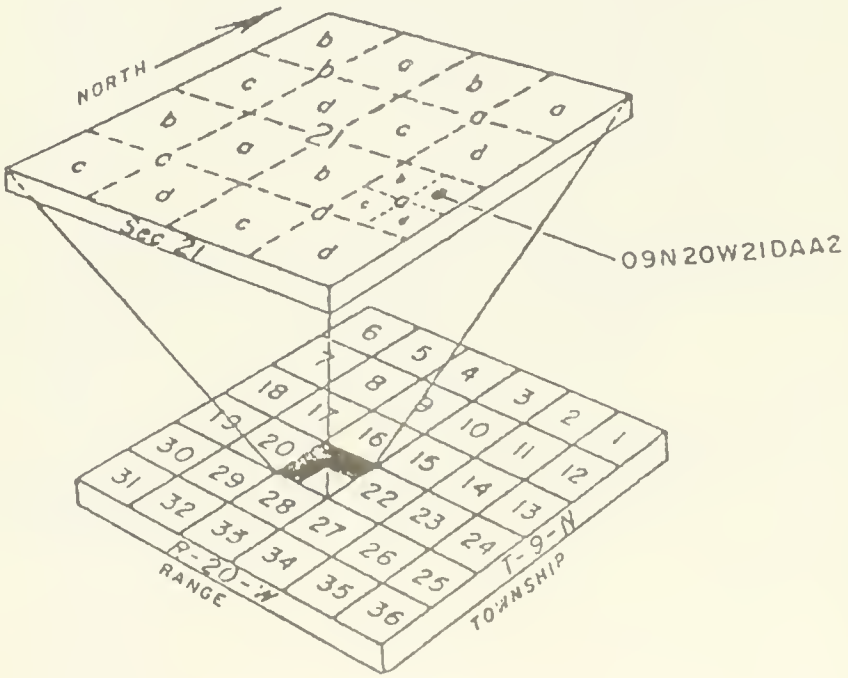
Material	Average Daily Concentration ug/l	Maximum Instantaneous Concentration ug/l
Total copper	50	90
Dissolved copper	30	30
Total zinc	100	200
Dissolved zinc	70	80
Total iron	300	1,300
Dissolved iron	150	150
Total lead	50	50
Dissolved lead	50	50
Total cadmium	10	10
Total arsenic	10	10
Total mercury	1	1

(History: Sec. 69-4814, R.C.M. 1947; AMD, Order MAC No. 16-2-5; Adp. 7/13/73; Eff. 11/5/73; MAC Not. No. 16-2-3; PRIOR P. 16-375 through 16-394.)

APPENDIX C

SYSTEM FOR GEOGRAPHIC LOCATION OF FEATURES

Wells, springs, water-sampling locations, and stream-gaging locations are assigned numbers based on the system of land subdivision used by the U. S. Bureau of Land Management. The number consists of twelve characters and describes the location by township, range, section, and position within the section. The figure below illustrates the numbering method. The first three characters of the number give the township, the next three characters the range. The next two numbers give the section number within the township, and the next three letters describe the location within the quarter section (160-acre tract) and the quarter-quarter section (40-acre tract), and the quarter-quarter-quarter section (10-acre tract). These subdivisions of the 640-acre section are designated a, b, c, and d in a counterclockwise direction, beginning in the northeast quadrant. If there is more than one feature in a 10-acre tract, consecutive digits beginning with 2 are added to the number. For example, if a water-quality sample was collected in sec.21,T.9N.,R20W, it would be numbered 09N20W21DAA2. The letters DAA indicate that the well is in the NE¼ of the NE¼ of the SE¼, and the number 2 following the letters DAA indicates there is more than one water-quality sampling location in this 10-acre tract.



REFERENCES

1. Department of Health and Environmental Sciences, 1971. Water Quality Management Interim Plan for Nashua, Montana, unpublished report, p. 8.

2. Comprehensive Area-Wide Water and Sewer Plan, 1970, Volume 3. Department of Planning and Economic Development, State of Montana.

3. Department of Health and Environmental Sciences, 1972. Water Quality Management Interim Plan for Havre, Montana, unpublished report.

4. Comprehensive Area-Wide Water and Sewer Plan, 1970, Volume 4. Department of Planning and Economic Development, State of Montana.

5. Engineering Report on Sewage Treatment Facilities for the Community of Hinsdale, November 1968. Turnbull & Plummer, Inc., Engineers, Great Falls, Montana.

6. Department of Health and Environmental Sciences, 1973. Water Quality Management Interim Plan for Glasgow, Montana, unpublished report.

7. Climatography of the United States, No. 60-24, Climates of the States, "Climate of Montana," Revised March, 1971.

8. Preliminary Survey Report, North Central Water Conservancy District, Montana State Water Resources Board, Henningson, Durham & Richardson, Helena, Montana. Parson, Brinckenhoff, Quade and Douglas, Inc., New York. December 28, 1970.

9. Census of Agriculture, 1964. Montana Bureau of the Census, U. S. Department of Commerce, pp. 258-263.

10. County and City Data Book, 1967. Bureau of the Census, U. S. Department of Commerce, pp. 223, 226.

11. Brown, C. J. D., 1971. Fishes of Montana.

12. Needham, Robert. Montana Fish and Game Department, Glasgow, Montana. 1974.

13. Gjersing, Frank, Montana Fish and Game Department, Havre, Montana. 1974

14. Ivey, Delbert. Mosquito District, Blaine County.

15. A Proposed Streamflow - Data Program for Montana, F. C. Boner and G. W. Buswell, U.S.G.S., Water Resources Division, Helena, Montana. 1970.

16. Study and Interpretation of the Chemical Characteristics of Natural Water, Second Edition. Geological Survey Water Supply Paper, 1973.

17. Nutrients in Natural Waters. Herbert E. Allen and James R. Kramer. Copywright 1972 by John Wiley & Sons, Inc.

18. Montana Water Pollution Control Program Plan, prepared for EPA, Region VIII, Denver, Colorado, June 15, 1974.

19. Helbun, N. et.al. 1962. Montana in Maps. Research and Endowment Foundation, Montana State College, Bozeman, Montana.

20. Montana Agricultural Experiment Station, 1969. Soils in Montana. Bulletin 621.

21. Soil Survey Staff, 1951. Soil Survey Manual. U.S.D.A. Agricultural Handbook No. 18.

22. Soil Survey Staff. 1928. Soil Survey of the Milk River Area, Montana. U.S.D.A., Bureau of Chemistry and Soils, No. 22.

23. State Water Conservation Board, 1967. Water Resources Survey, Hill County, Montana.

24. State Water Conservation Board, 1967. Water Resources Survey, Blaine County, Montana.

25. State Water Conservation Board, 1968. Water Resources Survey, Phillips County, Montana.

26. State of Montana, 1970. Comprehensive Area-Wide Water and Sewer Plan, Volume 3, Toole, Liberty and Hill Counties, Montana.

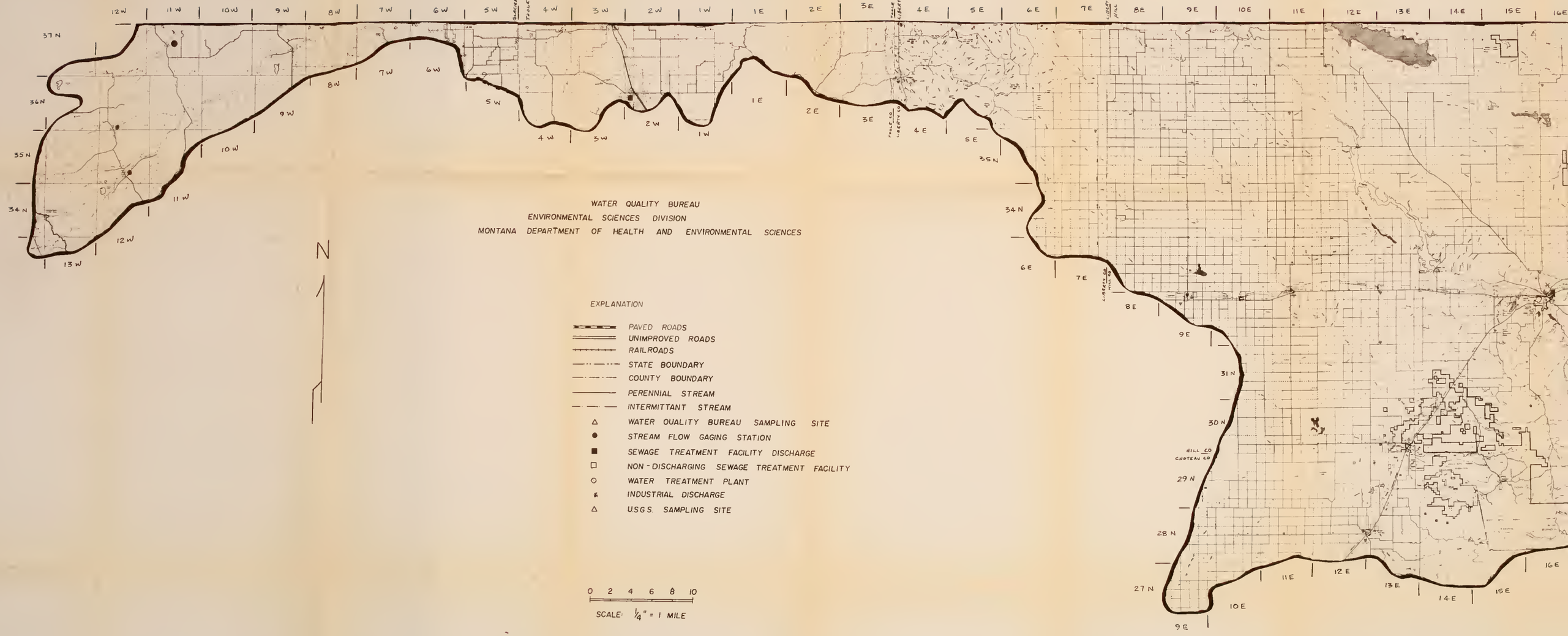
27. State of Montana, 1970. Comprehensive Area-Wide Water and Sewer Plan. Volume 4, Blaine, Phillips and Valley Counties, Montana.

28. Geology and Groundwater Resources of Northern Blaine County, Montana. Montana Bureau of Mines and Geology, Everett Zimmerman. Bulletin 19. November 1960.

29. Water Resources of the Cut Bank Area, Glacier and Toole Counties, Montana. Montana Bureau of Mines and Geology, Everett Zimmerman, Bulletin 60. May 1967.

30. Drainage and Water Supply Investigations in the Milk River Unit, Blaine County, Montana, 1962. U. S.G.S. open file.

PLATE I. PLAN M



WATER QUALITY BUREAU
ENVIRONMENTAL SCIENCES DIVISION
MONTANA DEPARTMENT OF HEALTH AND ENVIRONMENTAL SCIENCES

N

EXPLANATION

- PAVED ROADS
- UNIMPROVED ROADS
- RAILROADS
- STATE BOUNDARY
- COUNTY BOUNDARY
- PERENNIAL STREAM
- INTERMITTANT STREAM
- △ WATER QUALITY BUREAU SAMPLING SITE
- ● STREAM FLOW GAGING STATION
- ■ SEWAGE TREATMENT FACILITY DISCHARGE
- □ NON-DISCHARGING SEWAGE TREATMENT FACILITY
- ○ WATER TREATMENT PLANT
- ⁂ INDUSTRIAL DISCHARGE
- △ USGS SAMPLING SITE

0 2 4 6 8 10

SCALE: 1/4" = 1 MILE

NOTE: THIS MAP WAS COMPILED FROM MONTANA HIGHWAY DEPARTMENT COUNTY MAP SHEETS.

MAP OF MILK RIVER BASIN

STATE DEPARTMENT OF HEALTH
AND ENVIRONMENTAL SCIENCES
HELENA, MONTANA 59601

RETURN POSTAGE GUARANTEED